PMI

R. Rusta

VOL. 2 NO. 5
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PHOTO METHODS FOR INDUSTRY

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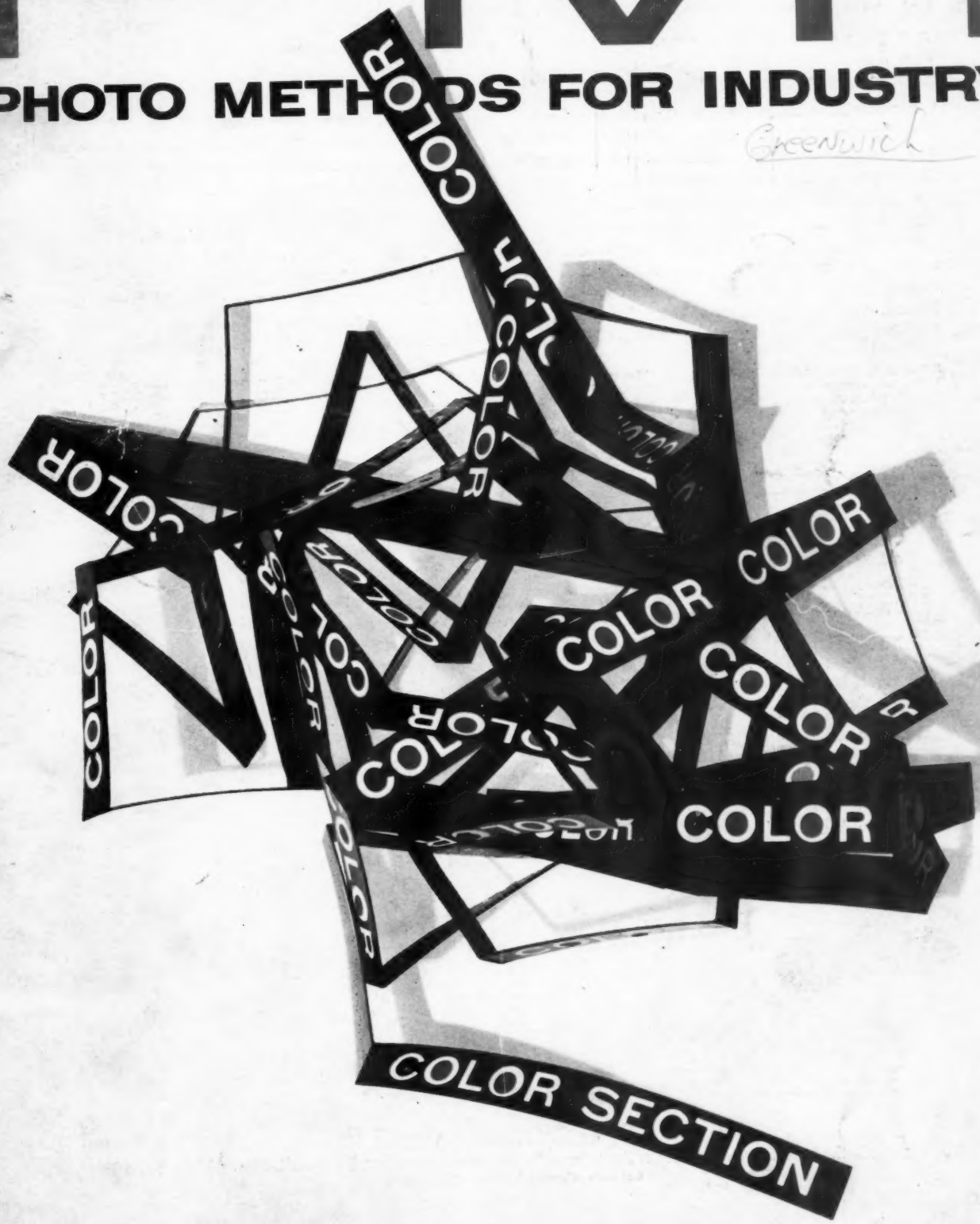

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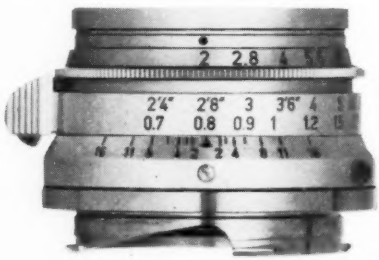

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MAY, 1959

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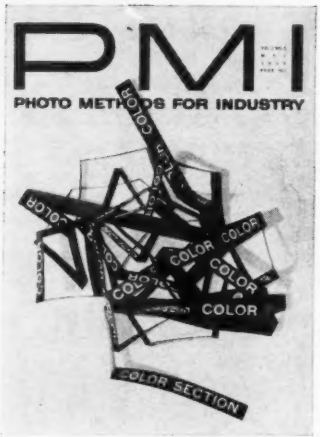

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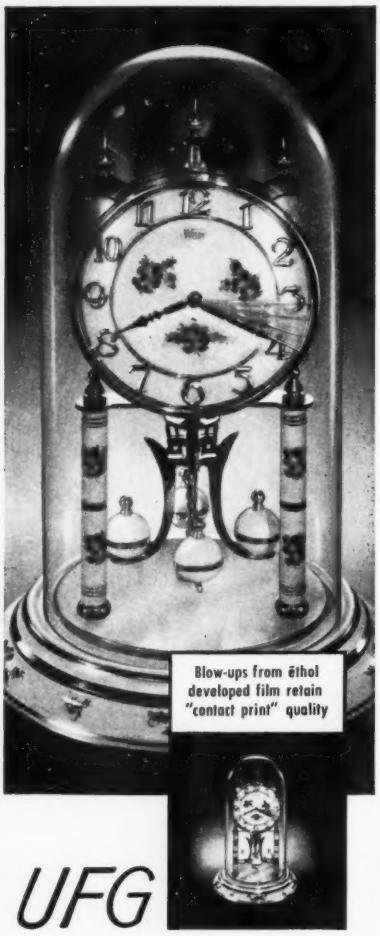

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F.Y.I.

Every day, Judy—who takes care of that sort of thing at PMI—brings in a pile of mail. One of the things that bulk up that pile is a device called a press release. The press release is a mimeographed sheet of 8½ x 11 paper, generally, and is sent to editors with the hope that the editor will somehow work it into the magazine. Rather than dash those hopes, we herewith quote from a selection of releases received within the past month:

George C. Connor, Sylvania VP, announced recently that "a scented substance has been added to the heat-resistant lacquer coating applied to the Blue Dot flashbulb line." We wish their sweet smell success.

Road Service

The Sanlu Art Supply Co., OR 9-4970, announced a cruising truck equipped with a radio-telephone for "on the road service" in supplying 107-in. wide background paper. They estimate delivery will require only minutes in midtown New York City. Pasadena calls take longer.

Eastman Kodak Co.'s Sales Service Division, Rochester 4, N.Y. will honor requests in writing for: *Kodak Portra lenses and a Technique for Extreme Close-Ups,* ‡B-10; *16mm Kodak Movie Films,* ‡D-22; *Kodak Color Processing, Printing and Duplicating Services,* ‡E-17; *Kodak Materials for Color Photography,* ‡D-41; *The Polycontrast Story,* ‡G-7; *and Photodrawings,* ‡P-22.

Speaking of Rochester, the Technical Association of Graphic Arts will hold its 11th annual meeting June 15-17 at the Hotel Manger. Lester E. Goda, Jr., chairman of Rochester arrangements, said a feature of the conference will be tours through the graphic arts facilities of the Rochester Institute of Technology and Kodak Research Laboratories.

According to Pellegrini-Piek, movie camera accessory specialists, there are "some 130,000 Bolex H cameras devoid of variable shutters." However, they can install a variable shutter unit which brings the camera "up to date." They boast over 2000 units currently in use throughout the world.

Lastly, the headline of a recent release from a Washington, D.C., firm: "BYRON NAMES CLINK HEAD OF SOUND SERVICES."

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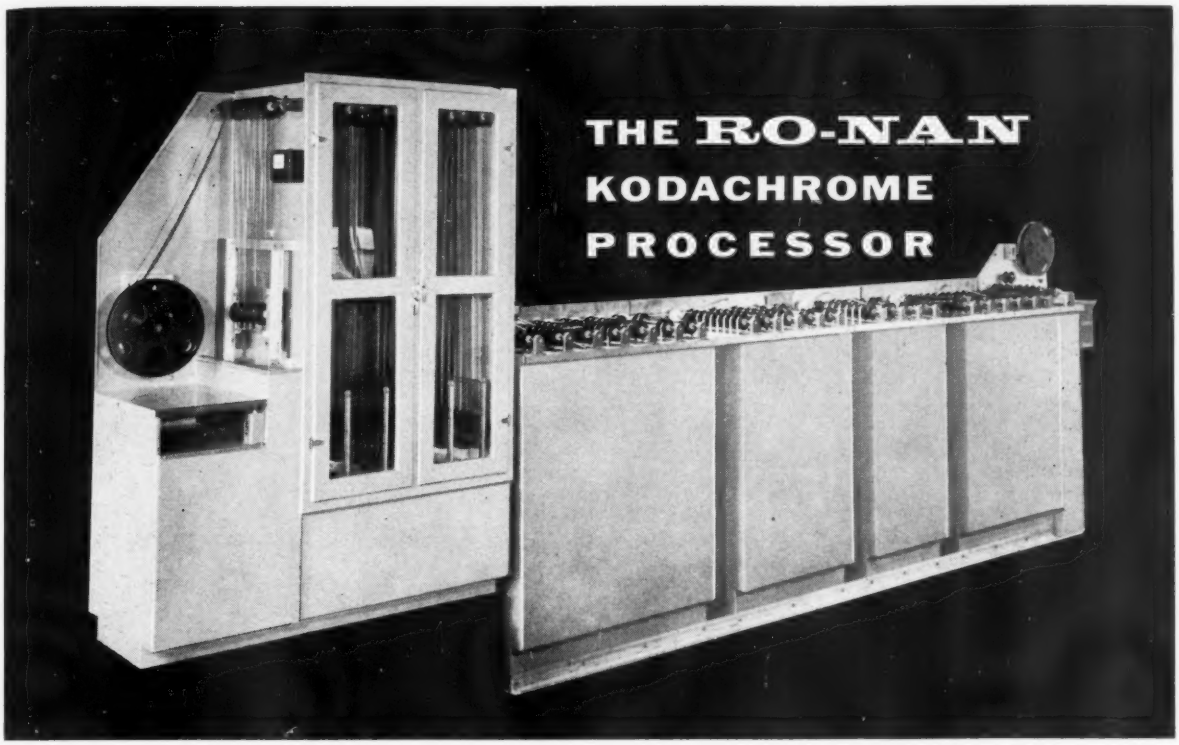

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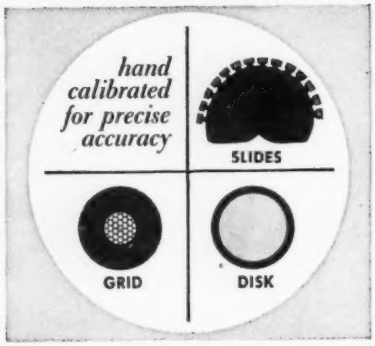

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by David B. Eisendrath, Jr.

WORKING PHOTOGRAPHER

Some comments on materials and techniques: think more, work less

Although the National Industrial Photographic Conference (July 25-31 in Los Angeles) is still several months off at this issue appears (and even farther away as this is written) plans and arrangements for it have been going on ever since last year's meetings. Indeed, the Steering Committee, ably conducted by Ed Purrington of Ford Motor Co., held nightly meetings during the 1958 Conference to get the up-coming show on the road.

Roy Wolford of North American Aviation, acting as Program Chairman this year, has lined up some new and interesting talent on a variety of subjects. Any industrial photographer, in-plant or out, who has any pride or interest in the field of functional photography should try to get there to learn what is new in the application of photography to industry, and to learn how other photographers are gaining recognition for themselves and their departments by making photography serve as an efficient production tool.

If you've ever attended any of these meetings before you probably know that each day there are opportunities for small groups to get together to discuss a variety of subjects from cost-accounting for small photo departments to photomicrography in petroleum research. These informal conclaves are often more revealing and productive than some of the more formal presentations because of the intimate exchange of ideas and experiences.

One of my very favorite programs which has been held for each of the past several years is an annual affair which is conducted by Jim Hampson of Arkansas Fuel Oil Corp. This is a program called "Methods and Techniques Forum" in which fellows (and girls) from the audience get up and tell and show (in actual demonstration or with slides) some of the little hints, kinks and tricks that they have been using in their own photo departments to make photography simpler or more productive on a small budget. Perhaps it is because I am admittedly a gadget man, myself. Basically a lazy guy, my theory of photography has always been to "think harder and work less"; so any little trick that eliminates a petty annoyance or solves a problem delights me. Each year I look forward to seeing Brother Hampson up on the platform calling up various volunteer speakers from the audience very much like a revival meeting testimonial session. I always learn a great deal, and if I can pick up a few techniques or tricks that make working in this field more fun, I feel that it's worth the price of admission (to the Conferences, that is).

Hints, kinks and tricks

Because I think you might like some of the methods and techniques that were given last year (and it might induce you to try to sell your management on your attending the conference in July) here are some of the stunts shown last year:

Jim Hampson started out by showing some of the items his company gives him to give away as gratuities to people who pose in pictures: lighters, pencils, auto thermometers, rain gauges, etc. Jim explained that when he photographed a man's Cadillac in a service station (Cities Service is Jim's company) he felt embarrassed at giving the man a dollar, and often the subject was offended, too. But a neat gadget as memento and for "valuable consideration" delighted the model and did some company advertising as well. Cute stunt!

Jim then showed how they made washers and dryers for roll films out of standard plastic 3½ in. inside diameter pipe such as is used in chemical and petroleum industries these days. By using a length of pipe and a cap or flange, with proper fittings they made washers that would hold any number of Nikor reels, and any kind of dust-free dryer you could

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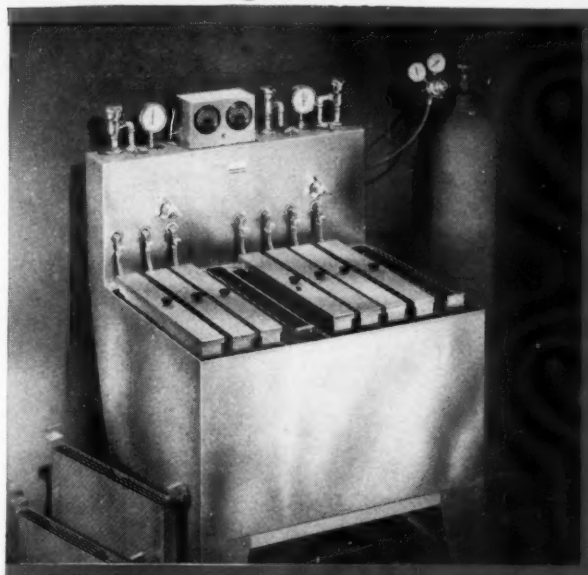

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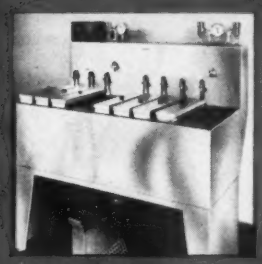

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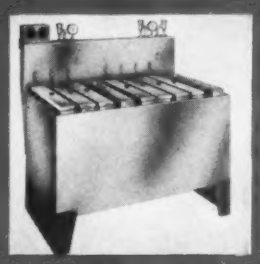

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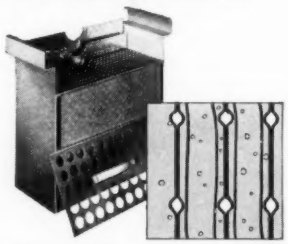

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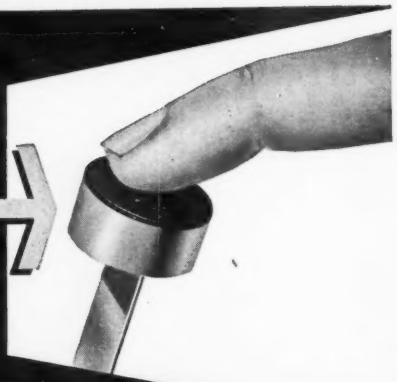

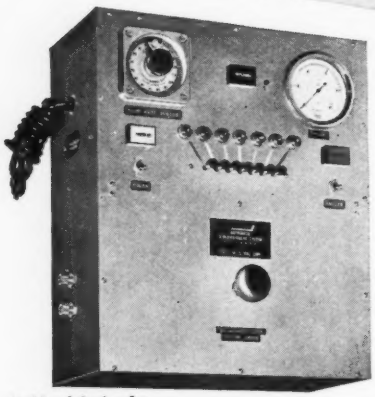

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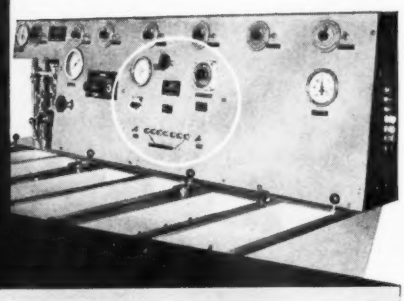

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think of. Dick Kinstler of Procter and Gamble showed a slide and some samples of photography of small shiny parts done in a unique tent. He uses a circular fluorescent tube which lies flat on a table over a sheet of white reflecting material. Within the circle of the tube is a small opaque platform covered with whatever is desired for the background of the picture. The subject is placed on this, and a cone of white plastic is then placed over the whole set-up, the picture being made through an aperture in the peak of the cone. Light shines up onto the sides of the cone and is evenly distributed and diffused.

Kinstler also showed how they make dupes of 35mm transparencies by photographing them over a piece of glass under which they place a curved reflecting surface and shoot an electronic flash at this surface. This evens out the illumination and allows them to put filters behind the transparency to be duped. To which this writer added a note that when making duplicate transparencies on Ektachrome or Anscochrome I got less contrast and better color saturation by exposing my color material at one-half or one-quarter of the rated speed and developing it for this exposure. The overexposure and reduced developing, of course, cuts down on the contrast and produces a better duplicate. Try it!

Dick Kimble of Westinghouse told of the technique they used of the small portable tape or wire recorder for recording captions in the field. Hampson, at this point, showed the way he had rigged a cradle to hold his regular (non-portable) recorder on the seat of his car, used with an inverter, to make captions in the field and explained how he used a gadget called the "Turner Third Hand" to hold the microphone to his mouth so he could make tapes while he was driving. Not only does he make reports to his office, but keeps up an active correspondence with many other industrial photographers by means of tape exchanges. As one of his correspondents, I added the note that I used a device called "FilMagic Pylon" (Distributor's Group, Atlanta, Ga.) on my tape recorders and motion-picture projector. This small applicator, permanently mounted on the instrument, lubricates and cleans tape or film as it is moving and saves the recording head, as well. . . .

This gives you an idea of the kind of interchange of ideas that goes on endlessly at these meetings. Hey—will you be at the National Industrial Photographic Conference this year? Work on it!—THE END

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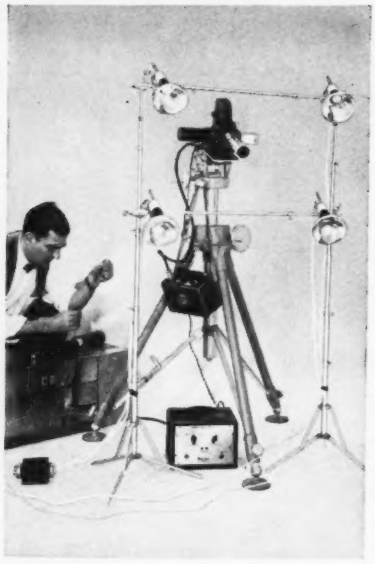

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Get more information. Circle 428, page 61

by Vernon D. Tate

MICROREPRODUCTION

Micro-hunting: where and how to get information on microfilming

How does an inquirer find proper answers to questions about microreproduction or secure useful information about the field? Actually there are about as many approaches as there are individuals but one or all of five general lines of inquiry are usually productive. These include:

1. As in any scientific problem, make a literature search.
2. Observe a going operation in the particular field that is of immediate concern.
3. Inquire of trade associations.
4. Contact manufacturers.
5. Consult an "expert."

Before setting out on any one of these courses, it is useful if not essential to think the problem through and determine why the information is wanted and the purposes for which it is to be used. Most individuals wish to use microreproduction techniques in connection with one or more problems related to other work; they may wish to enter some phase of the business professionally or as a hobby; they may have an "idea" or they may wish to extend their photographic knowledge by exploring what after all is a fascinating and rapidly growing segment of the field. The need will determine the course and the depth of the inquiry.

S.O.P.: literature search

A literature search is standard operating procedure in scientific research and the careful approach of the trained research man yields maximum results in a minimum of time. The best source of literature is a library, the larger the better. If the inquirer is not trained in documentary research then ten minutes spent with a friendly reference librarian will be well worth while.

Since libraries themselves make use of microreproductions in many forms and usually own some equipment, the department or librarian concerned with these activities is also a good source of information. The Photoduplication Service of the Library of Congress in Washington, D.C., is one of the largest and best equipped in the country. An interesting descriptive pamphlet has been published about it, and if copies are not now available in the original, a microfilm copy can doubtless be purchased. Another Library of Congress publication of value especially for academic use is a bibliography, *Microfilms and Microcards: Their Use in Research* by B. P. McCrum (1950). It contains 263 annotated references and a topical index.

Books, recent & useful

The Library card catalogue will reveal several useful books. Among them is Lewis & Offenhauser *Microrecording* (1956) which is devoted to industrial and library applications. It contains information about technology and equipment, references for further study and a section on standards. For equipment, the National Microfilm Association's *Guide to Microreproduction Equipment* edited by Hubbard W. Ballou which has just been published (1959) affords the best and most up-to-date coverage of the field. In this book do not fail to note the addresses of manufacturers and distributors which appear on the descriptive sheets with particular pieces of equipment. They are good sources of additional literature and information. Another book just published by NMA is *Microfilm: A History, 1839-1900* by Frederic Luther (1959). It contains a wealth of detail about the early history of microfilm and is most interesting reading. The advanced technician or specialist may find *Microphotography: Photography at Extreme Resolution* by G. W. W. Stevens (1957) of more than passing interest although the coverage of documentary microphotography is limited to one small section. There are some valuable articles under the appropriate headings in the *Encyclopedia of Photography* edited by Willard Morgan (1942-3). Technical and other abstracts can be found in the

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Micro-Master 105mm offers the general advantages you expect of any miniaturization system – space savings, protection of costly originals, and ready distribution of duplicates. But Micro-Master provides these advantages *without* over-mechanization. A 105mm negative – measuring a generous 4 by 6 inches – is large enough to be located easily and read quickly without elaborate scanning and sorting devices. In addition, a national network of K&E dealers stands ready to provide the 105mm service you need.

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Micro-Master is a totally integrated system for photographing, film processing and final reproduction or projection printing. Completely precision-engineered – from optics through films, papers and chemicals – the system provides extremely sharp, high-contrast "thin" negatives that furnish high-quality, absolutely uniform prints. Critical alignment of camera and projector, and special vacuum frames which hold materials absolutely flat, are typical of the optical and mechanical features that make the Micro-Master system an engineering aid of highest quality.

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Old originals can be restored, too – even when badly damaged. The Micro-Master process uses *reflected* rather than transmitted light. Thus, detail which has been lost through light absorption – due to dirt or discoloration – will "snap back" on the film – giving you clean prints with clear backgrounds and sharp black lines equal to ink lines. The large negative size makes it easy to see and eliminate unwanted areas by "opaquing out." Any small paint brush can be used for this purpose.

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Micro-Master is a miniaturization system providing *individual* negatives that meet archival requirements. Each negative is kept in its own 5″ by 8″ envelope. There is ample space on the envelope for large, legible identification coding and other information. Over 12,000 drawings can be stored in a standard 5″ by 8″ card file cabinet. No complicated cross-indexing is needed, for negatives of original drawings and all subsequent revisions can be grouped in the same file, ready for immediate reference. The absence of sorting devices eliminates scratches and other film damage resulting from excessive mechanical handling.

See Your K&E Dealer for Information, Equipment, Service

A camera, projector, three types of viewers, and all necessary printing accessories are available with the Micro-Master system, and all equipment can be obtained through your local K&E distributor. He can also furnish 105mm reductions and enlargements of your drawings as a service. For complete information, call your K&E dealer, or write to Keuffel & Esser Co., Dept. PM-5, 300 Adams St., Hoboken, N. J.

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Get more information. Circle 437, page 61

files of the *Ansco Abstracts*, the *Monthly Abstract Bulletin* of the Eastman Kodak Company and in *Photographic Abstracts* published by the Royal Photographic Society of Great Britain. Standards fall within the purview of the American Standards Association and its publications.

If detailed information about a particular field is sought, it is often possible to find a local firm engaged in the precise operation. Most banks, department stores, insurance companies, manufacturing firms and other branches of business and industry make use of some form of microreproduction. A search in the "yellow pages" of the telephone book will usually reveal a local microfilm service company who can direct an inquirer to the proper location and person unless he happens to be a real or potential competitor. If unsuccessful or in doubt consider the several governmental structures, federal, state and local. At all levels microreproduction is employed extensively in myriad connections. If you are a taxpayer (and who is not?) this fortunate status is an open sesame to much information. A letter to a Congressman or Senator asking a specific question, as for example how microfilm is used in connection with Veteran's records, with the Census, at the Treasury and so on will often elicit a complete reply.

Associate!

Trade associations are a good source of data. In this field the National Microfilm Association (P.O. Box 386, Annapolis, Maryland) holds a convention each year in one of the principal cities. The 8th Annual Meeting and Convention was held this year April 2-4 in Washington D.C. (as announced in PMI). There was an extensive exhibit of equipment and a full program of technical sessions. The papers read at these meetings are published as *Proceedings* (usually files are available in larger libraries) which are a mine of information about every aspect of the field from equipment, technology and practice to applications. In addition to *Proceedings*, NMA publishes a *Glossary of Terms Used in Microreproduction* edited by Hendrix TenEyck (1955), resolution charts for camera test and a bi-monthly news sheet, *National Micro-News*.

Some mention has been made of manufacturers and suppliers in the field. They are interested in selling their products and make a regular practice of preparing and distributing literature that ranges in scope from advertising brochures to full

(*continued on page 57*)

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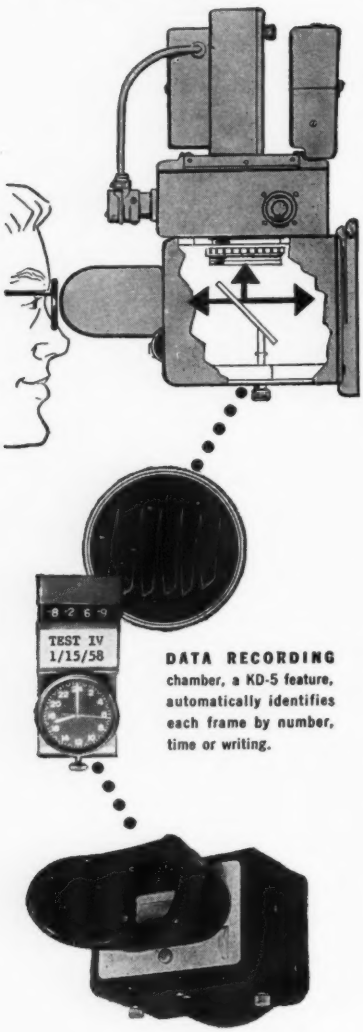

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by Ernest E. Reshovsky

PHOTO INSTRUMENTATION

Man-in-space vehicle, North American X-15, bristles with cameras

EDWARDS AIR FORCE BASE, CALIF. — Here in the middle of the Mojave Desert, America is testing its entry in the race to put a man at the fringe of space—the rocket powered X-15.

North American Aviation Inc., the builder of the ship, the Air Force and the National Aeronautic and Space Administration (NASA) are conducting the tests jointly. Although test results are cloaked in secrecy, the means of obtaining the data are not.

We discussed the problem of instrumentation data recording with Gerald M. Truszynski, who is Chief of Instrumentation Division of NASA High Speed Flight Station here.

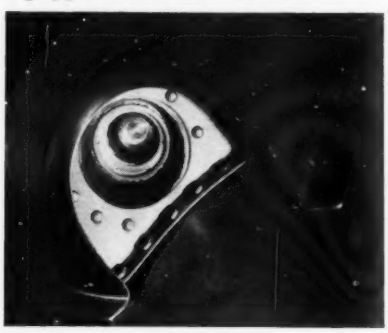
Most of the data recording on the X-15 is photographic. During the re-entry into the earth's atmosphere, for example, four cameras (Vought 16mm VDR 4) in the plane, will record structural deformations. These cameras, operating at 10 fps, are pilot-controlled and will operate only during the re-entry period when the plane is fully operational. These VDR 4's are installed within the plane fuselage, will shoot through prisms which are covered by protective bubbles so external protuberances are kept as small as possible. They will furnish direct photographic records of wing and tail surfaces.

Oscillographic recorders

Another set of photographic devices, 18 self-contained oscillographic recording instruments within the plane, delve into: 1) stability and control information, 2) structural and system temperatures and 3) aerodynamic and strain load pressures.

Truszynski says that from past experience NASA considers photo oscillograph recording one of the most reliable instrumentation methods.

An example of "stability and control information" is the airspeed record. This is compiled by means of pressure differential fed from the nose probe of the plane to a pressure cell in a recorder. The pressure cell has mirrors mounted on it which reflect a light source to produce a changing oscillographic curve upon the film. A record of static pressure provides altitude information by means of a similar recording device. To produce data of acceleration, three pivoting devices, each of which indicates acceleration along a single axis, are equipped with small lenses which, through a mirror system, deflect a stationary light beam to produce traces on film. Position of the control surfaces of the plane are recorded through a potentiometer and a reflecting galvanometer onto film. Angular velocity is plotted by means of "restrained gyroscopes" which, equipped with mirrors, deflect stationary light beams to produce a photographic line trace.



Behind bull's eye; prism and camera

To plot structural temperatures a large number of thermocouples have been incorporated in the design of the airplane. The output of the thermocouples is fed to 12 recording galvanometers. By use of mechanical switches as many as 440 different points are sampled and recorded on film each second.

To assemble data on structural stresses within the aircraft ("vehicle" is the official designation of the X-15)—110 strain gauges are built into the structure. Data from 36 of these gauges at a time are fed into galvanometers which record the information of film. The choice of which group of 36 of the 110 available gauges is connected to the recording

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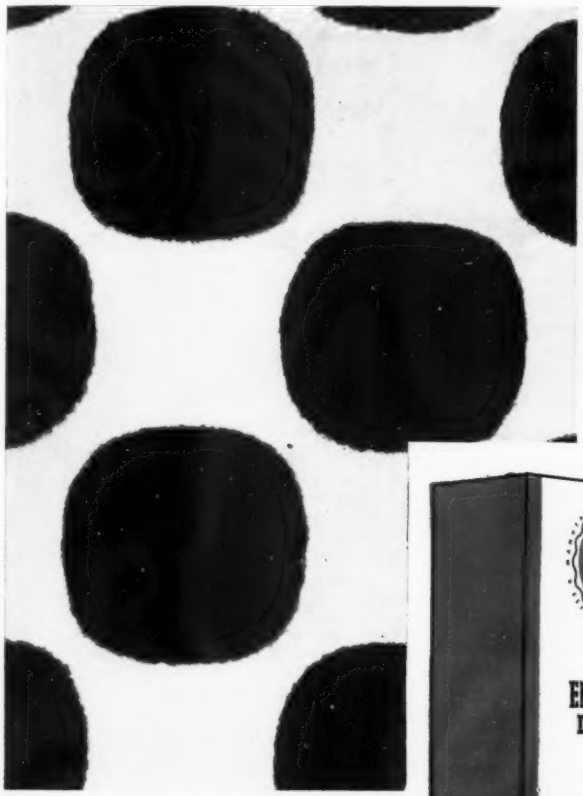

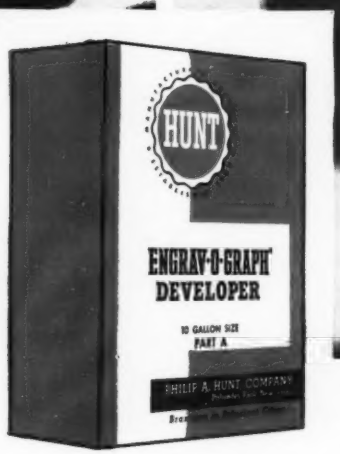

Engrav-O-Graph Developed Negative

Unretouched photomicrographs (magnified 150 times) of two halves of a test film exposed through a 133 line screen

"X" Brand Developed Negative

of a standard gray scale. Both halves were developed for 2¼ minutes at 68°F. Note the complete absence of halation in the film developed in Engrav-O-Graph.

Make this simple test

1 Order a carton of Engrav-O-Graph, on the money-back guarantee. Make up a solution according to directions.

2 On your next camera job, shoot an extra negative for your test.

3 Cut the negative in half, notch for identification, then run one half through your regular developer, one half through the Engrav-O-Graph developer. Keep time and temperature the same for both developers.

4 Fix and dry both test strips the same way. Then rejoin the negatives on your light table and examine the dots in identical areas with the most powerful magnifying glass you have. The microphotographs above show you what to look for. Notice that the shadow dots are harder, the highlight dots are cleaner and sharper in the Engrav-O-Graph developed portion of the negative.

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Get more information. Circle 438, page 61

"VICTOR PROJECTORS JUST DON'T WEAR OUT"

Victor owners from all over the world tell how their 16mm sound projectors have turned in extra years of trouble-free service.

Here are just a few unsolicited comments . . .

Fifth oldest sound model still running

"The Victor projector is in good operating condition, sound and picture," says Mr. Dale W. DeArmond of Wichita, Kansas, in describing his Victor Model 12. The machine, built in 1933, is the fifth 16mm sound-on-film projector ever made. "The original finish has only a few worn places . . . This projector is a wonderful machine, impossible to ruin a film with all those safety devices."

Only a burned out bulb

"We believe that it is amazing that this [Victor] machine, after being in continuous use since its purchase years ago and having such hard usage, is still in service," reports Mr. J. F. Steiner of the Steiner Studio in Elmira, N. Y. "The writer does a lot of traveling in Canada every year to fish and always takes the projector along to show movies taken the previous years. If you have ever traveled on some of these Canadian roads in the backwoods, you know what we mean about hard usage of the projector. The machine has never been returned for repairs, and has required no replacement parts other than a burned out bulb."

Never lost a foot of film

A film technician for the Army Pictorial Service in Long Island City, N. Y., Mr. Charles French has this to say about his Victor Model 25, manufactured in 1936. "I always boost the Victor for two reasons. The first is the automatic trip. In all the eleven years I have owned this machine I haven't lost a foot of film. The second is the gate runners. I have never had a scratched film due to my projector. I have operated many other makes and had to use emery paper on the runners, even when they were new."

Plunged 4½ feet to the floor

Reverend J. Samuel Pritchard of the First Evangelical United Brethren Church, Veedersburg, Ind. tells of his experience with a Victor Model 25, manufactured in 1936. "While showing a film for our Brotherhood about 4 years ago one of the setscrews of my projector stand wasn't tightened enough and the projector plunged about 4½ feet or more to the floor. I thought it was done for and suggested that the Brotherhood might like to buy a new one. They didn't. But the blacksmith took the poor old projector home, patched it up and it is still working."

Doing yeoman service

Mr. Frank A. Valenti of Brooklyn, N. Y. states that "I am the proud possessor of a Victor Model 24B which has done yeoman service in my work with mentally retarded children." This machine was built in 1935 and is "still in excellent condition."

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galvanometers depends on the information desired from various test flights. The 18 oscillographic instruments, many of them NASA-designed, standardize on one of two film sizes: 2 7/16 in. or 6½ in. x 50 ft.

In addition to all this photographically recorded flight data, according to Truszynski, a certain amount of geophysical information will also be recorded photographically once again

The X-15: up to here in cameras

when the aircraft becomes fully operational. The ship will carry stacks of plates to measure radiation which it will encounter at its full design altitude, about 100 miles. An attempt will also be made to measure sky brightness, but Truszynski is careful to point out that this will be an attempt only. To do this, photo-electric cells will be connected to recording galvanometers, which will then plot the data on film. The choice of material of the photo-cells will depend on the spectral information desired.

All data recorded on film via the many instruments carried aboard the aircraft will be read out on magnifying film readers and transferred to IBM punch cards for tabulation.

Ground tracked!

The aircraft is tracked, meanwhile, by ground radar all the way along its flight path. Radar data is recorded magnetically on tape, but the radar units are equipped with Automax G2 bore-sighted cameras mounting 80-in. lenses for additional data.

When the fully-operational ship comes in for a landing here at Edwards AF Base, ground photo theodolites operate to record its operation: Askanias mounting 3,000 and 1,000mm lenses will be used for long-range photography, while the touch down will be recorded by Fairchild and Akely cameras. —THE END

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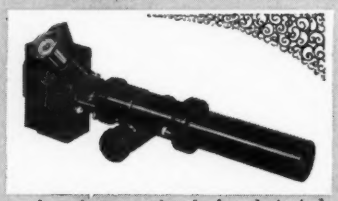

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by Herbert P. Paschel

REPRODUCTION & GRAPHIC ARTS

Got a match buddy? Color Center throws new light on the subject

Not too long ago it was a common sight to see shoppers emerge from a store carrying a bolt of cloth or some article of clothing, examine same and return inside. The purpose? To check the appearance of the item in daylight. Through bitter experience shoppers learned of the considerable difference in the visual appearance of colors in natural and artificial light. Since daylight is the dominant illuminant in our daily lives, it was no more than common sense for shoppers of previous decades to prefer making critical decisions about color in daylight rather than by the yellowish incandescent store light.

Shoppers of the present generation are not faced with such problems. Modern stores are generally equipped with lighting that simulates the light under which the article purchased will be used or worn. In fact, stores today cleverly use light to enhance the appearance and appeal of their wares. A supermarket, for example, will very likely employ light of different spectral composition in the meat and vegetable displays both of which, in turn, will differ from the general lighting.

While most of us are aware of the influence of light on what we see, very few realize the extent of the visual differences created by the light sources most commonly encountered.

Interchemical pins 'em down

One of the few places where the graphic arts technician can observe the startling transformation of observed color under different illuminants is the new Interchemical Color Center, maintained for Interchemical Corporation's research in graphic arts and open to outsiders on application. A unique six-stage lighting system can, with the flick of a switch, reproduce the lighting conditions under which people dealing with color most commonly work. A false ceiling of aluminum honeycomb baffles masks the many fixtures needed for the variable lighting system. The six kinds of light that can be created were selected for their popular usage in the appraisal of color. Each supplies over 100 foot-candles at the plane of inspection.

Simulated north skylight, at a color temperature of 8000K, is the highest in blue content.

Simulated overcast north sky daylight, at a color temperature of 7400K, is the type of illumination recommended by the Research and Engineering Council of the Graphic Arts for color matching.

Average daylight, at 6700K, is the standard suggested for use when color measurements are conducted (1CI Illuminant "C").

Super deluxe cool white fluorescent light is representative of the lighting in supermarkets and retail displays.

Color transparency illumination, at 3800K, is the light used in several popular transparency viewers. The same color temperature is recommended by several groups for comparing proofs with transparencies.

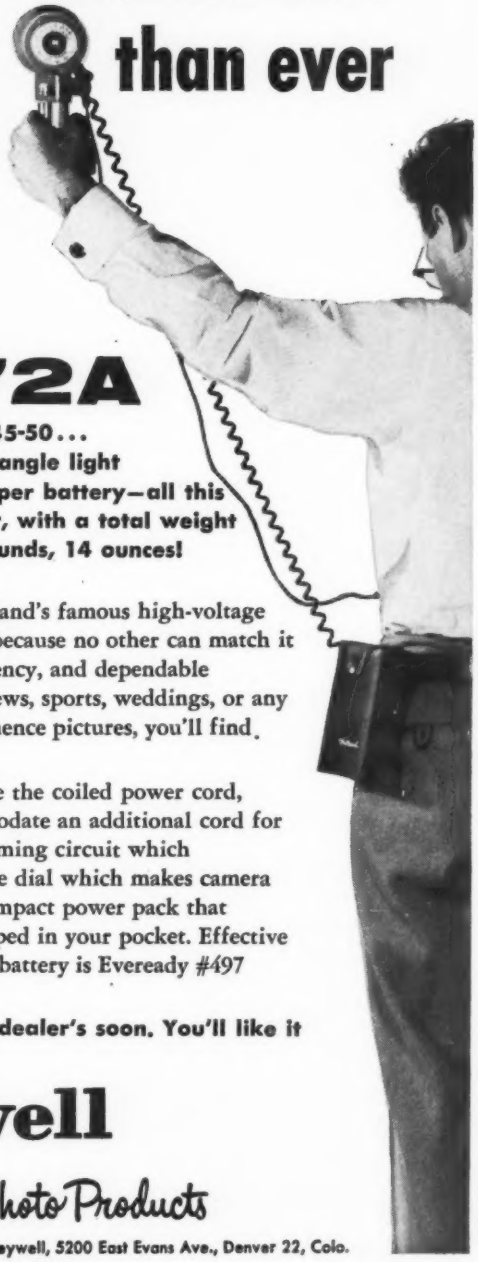
Tungsten light, at 2800K, is the normal incandescent light in the home.

The ease with which these different kinds of light can be produced enables the Center to vividly demonstrate the visual changes in a color sample with changes in the light.

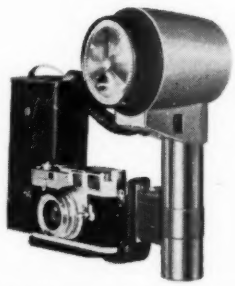
In color reproduction there are innumerable steps where critical comparisons and judgments are necessary. If made under widely varied

Color Center: changes startle you

more light output than ever... smaller size than ever



the all new Heiland STROBONAR 72A



The 72A can be mounted on virtually all cameras by choosing the proper Heiland brackets and shutter cords. It accepts the Heiland Model E Clamp, Quick-Release Clamp, or Graflex mounting rings.

Kodachrome guide number of 45-50... 2-6 second cycling... 70° wide-angle light distribution... 600-800 flashes per battery—all this in a smaller package than ever, with a total weight (*including* battery) of only 3 pounds, 14 ounces! That's the new Strobonar 72A.

Here's a unit designed around Heiland's famous high-voltage system, preferred by professionals because no other can match it for quick cycling, maximum efficiency, and dependable service. If you shoot fast-moving news, sports, weddings, or any other event that calls for rapid-sequence pictures, you'll find the 72A in a class by itself.

Other features you'll appreciate are the coiled power cord, detachable at *both* ends to accommodate an additional cord for extension; the special capacitor-forming circuit which adds battery life; the large exposure dial which makes camera settings quick and easy; and the compact power pack that can be snapped to your belt or slipped in your pocket. Effective exposure time is 1/1000 sec.; 510 v battery is Eveready #497 or equivalent.

See the Strobonar 72A at your dealer's soon. You'll like it because it's made for you.

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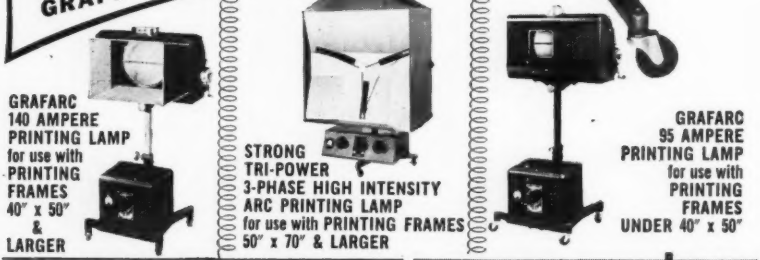

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lighting conditions, the observed results will likewise vary and lead to errors in color fidelity and estimating corrections, disagreement among workers and customer dissatisfaction.

In the course of translating a colored original to the printed page two types of comparison are made. The most important of these is comparing the original to the proof or production print. It is important that this type of inspection and evaluation be performed under an illuminant that equals that normally prevalent at the point of use. Such a practice eliminates two troublesome variables —a mismatch because of differences in the composition of the illuminants, and a mismatch due to metamerism. Since the original and the reproduction contain different colorants a metameric match is always a possibility. (Dissimilar colorants are not likely to follow the same pattern of visual change with different illuminants. Two dissimilar colorants may visually match under one illuminant but prove to be a gross mismatch under a different light source. The apparent match in the one instance is considered a metameric match.)

Flexible uniformity

When comparing first and second proofs, or OK'd proof and press sheet, we are comparing similar colorants, assuming of course that the same paper and ink were used in both cases. With similar colorants the possibility of metameric matches is ruled out and a certain amount of choice is possible as to the quality of the light for this type of evaluation. It is only necessary, within a given plant, to provide the same quality and intensity of light at all points where similar evaluations are made.

Because the products of reproduction plants are viewed or used under such a wide variety of conditions, the illuminant problem is much more acute than in many other industries. Obviously, a single standard illuminant could not satisfy all possible conditions. The set-up at the Color Center suggests a possible solution. A central inspection area with variable lighting in each reproduction plant would provide a point for critical evaluation under the most commonly encountered conditions. Other inspection stations, where only color uniformity is checked, could be simpler and in accordance with the recommendations of the Research & Engineering Council of the Graphic Arts. The combination of the two would not only provide flexibility and standardization within a plant but would likewise establish uniform industry standards.—THE END

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by Edward R. Farber

ELECTRONIC FLASH

Philadelphia sunny side up: Farber unscrambles 9 new speedflash units

New electronic flash units parade into the market place with almost disconcerting regularity. The recent photographic dealers' (MPDFA) show in Philadelphia saw the announcement of nine new models by six manufacturers. Perhaps only the single-lens reflex field leaves the consumer so confused.

This writer looked and listened, but did not get a chance to test the equipment discussed here. Best advice I can offer for deciding whether or not to buy a specific piece of equipment is to re-read the Electronic Flash Evaluation Chart (available free from PMI, 33 W. 60th St., New York 23, N.Y.) and then go shopping. Finally, try the units that seem most suited to your needs. Check exposure claims and reflector coverage particularly. Some claims are conservative, some optimistic.

Vanguard and Hershey both have new completely camera-mounted units. The Vanguard is complete in a tubular battery-case design which features a tilt up lamp head for bounce flash. All specifications are the same as for previous models with a Kodachrome guide of 30 to 40. Charger for the permanent-installed nickel cadmium battery is built-in. The Hershey is built as a small flat rectangular case which carries a detachable rectangular lamp head snugly fitted to the top. This transistorized unit uses either regular or nickel cadmium batteries to give a suggested guide of 40 with Kodachrome. Charger is built in.

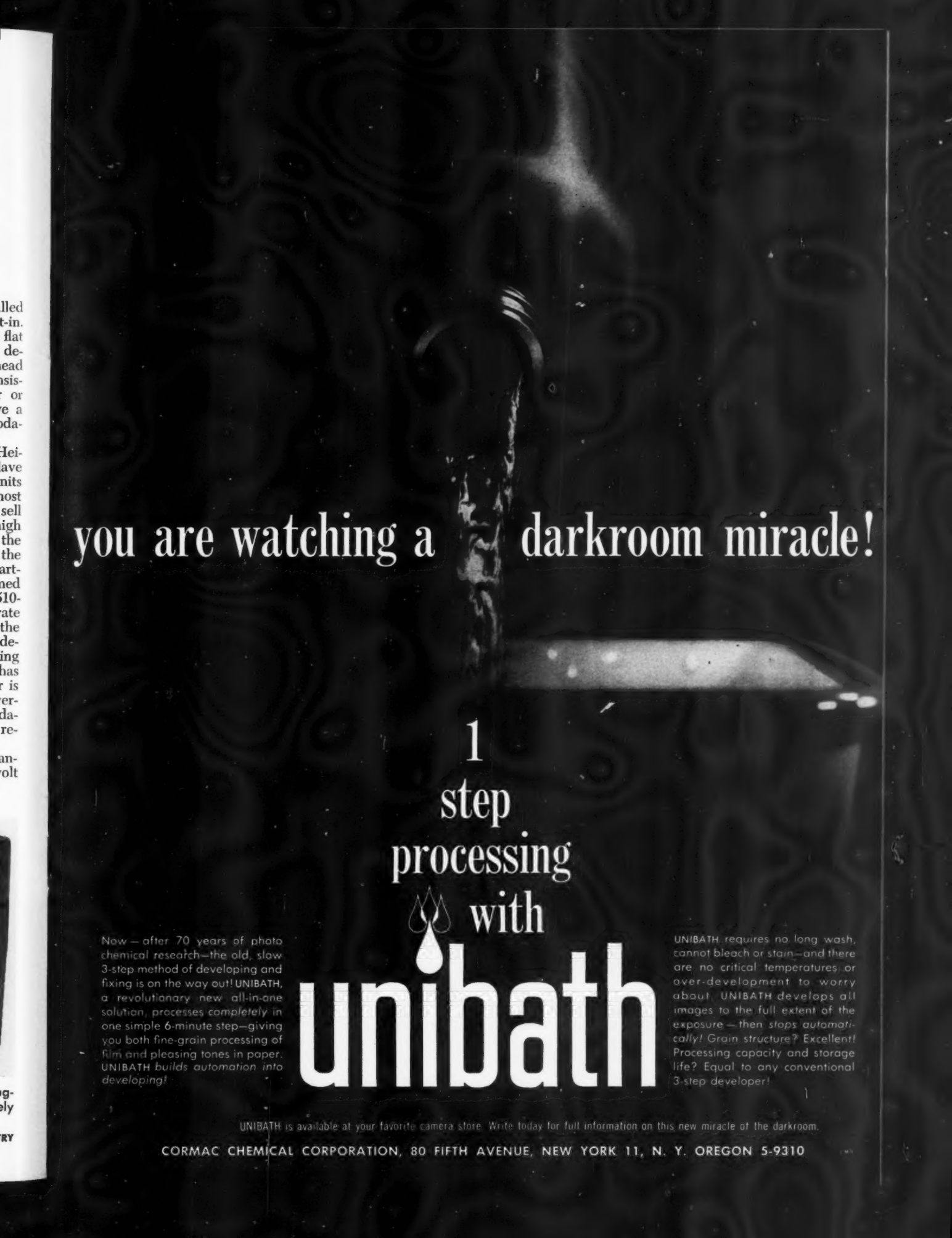
Both Hershey and Honeywell-Heiland have new photoelectric slave controls to operate their own units and which are said to work with most other speedlights as well, both sell for $19.95. Heiland has added a high voltage dry battery version of the Futuramic Strobonar to its line, the 72A. The tubular battery compartment of the unit has been shortened and contains a capacitor. The 510-volt battery is carried in a separate leather pouch. A nice feature is the self-contained capacitor forming device which insures against running down of battery when the unit has been idle for weeks. The reflector is designed to give a 70 degree coverage. It has a recommended Kodachrome guide of 45 to 50 and recycles in 2 to 5 seconds.

An interesting design of the Japanese firm Walz Ltd., uses a 240-volt

(*continued on page* 70)

Left to right: power pack, new Heiland Futuramic 72A, $19.95 slave

Hershey unit is self-contained, snug-fitting head may be removed entirely



Now — after 70 years of photo chemical research—the old, slow 3-step method of developing and fixing is on the way out! UNIBATH, a revolutionary new all-in-one solution, processes *completely* in one simple 6-minute step—giving you both fine-grain processing of film and pleasing tones in paper. UNIBATH *builds automation into developing!*

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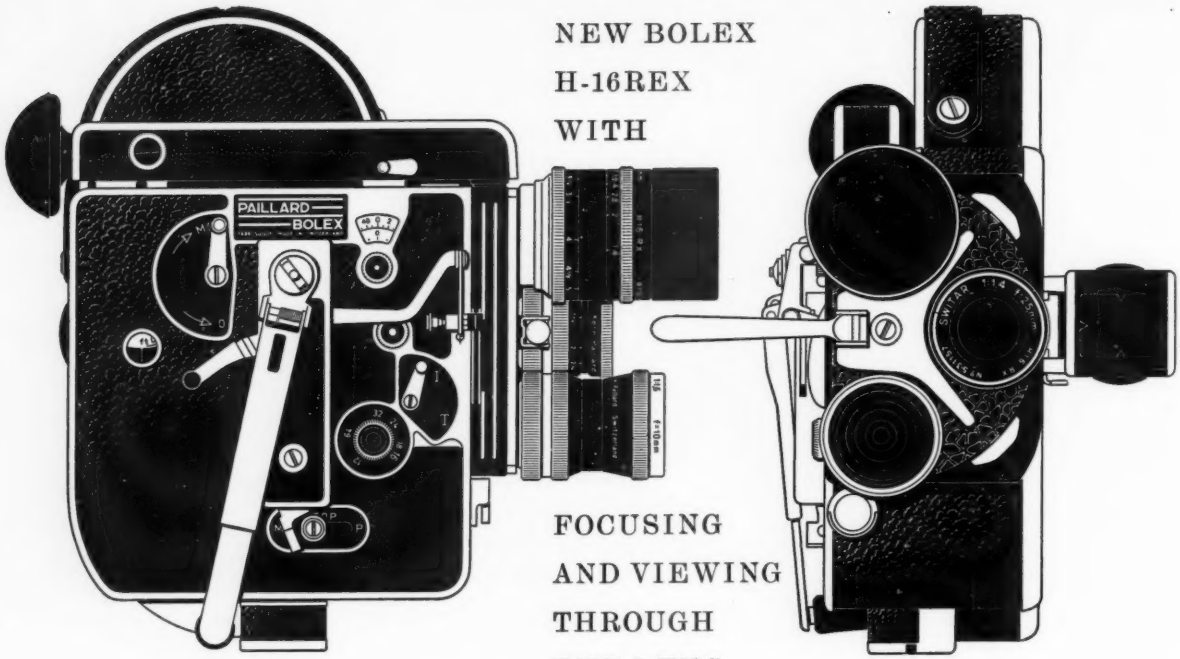

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THROUGH
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Fades and lap dissolves are smooth and easy with this new 16mm Bolex Reflex. The new variable shutter is operated by a lever next to the trigger. A touch of your fingertip now gives perfect fades.

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1. For bright scenes ordinarily requiring a gray filter or closed diaphragm, now simply cut exposure time with partly closed shutter.

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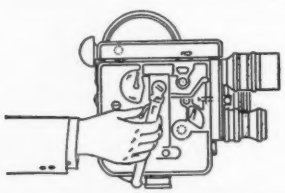

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Get more information. Circle 467, page 61

AN EDITORIAL

NEEDED: SCRAPPY STEPCHILDREN

Industrial photography has arrived, but the industrial photographer has not. He is underestimated, overworked, underpaid and misunderstood. Industry has discovered it needs the photographer and industry wants him, but not all that much.

What is wrong? Well for one thing, photography is like most service functions in that it is at a psychological disadvantage compared to production, sales and research. Production and profit are the first concern of management. Other necessary but secondary matters are usually afterthoughts; "stepchildren" is the way many photographers phrase it.

The same stumbling block faced other non-production roles in industry: law, medicine, research, personnel, traffic, public relations, advertising, science, even engineering. The photographer is apt to envy them for their prestige, but the truth is that in most every case, their status is the prize of a long struggle, a struggle as old in some cases as modern industry itself.

Photographers can and have taken a leaf from other industry servants. In isolated cases photo departments have won the recognition they deserve. How did they do it? Through the application of some simple reasoning: 1) Industry wants to increase productivity, save money, get more customers, and get a jump on competition. 2) Photography can help in each of these efforts. 3) Therefore let's make damned sure that no opportunity to apply our skill to these ends goes unused. That takes imagination, persuasion and work—but in the long run it's worth it. 4) There's one more step. Keep the men who make the decisions apprised of the value of photography to them. If photography is a stepchild of industry, we'll be able to prove it a worthy offspring, even in its infancy.

The Editors

COLOR

THE BIG SHOT

Wide open spaces may be fun to roam in but they present a lighting headache to cameramen who have to photograph them. Sometimes the hard ones call for the most interesting solutions—like these answers that Port of New York Authority photographers found when faced with three big, big shots.

The Big Shot in this story is not the formal portrait of the Chairman of the Board but the assignment that calls for photographing acres and acres of space, where the basic problem is getting enough light for a good picture. The Port of New York Authority, which runs New York's major bridges, airports, tunnels and harbor, has a good supply of space and a photo section which is quite skilled at taking pictures of same. The first picture, of Newark Airport's Terminal Building, is an example of how to fill up space with light, 18 flashbulbs being used for each picture, in addition to 500 ft. of wire. In the second picture, the assignment called for a shot at dusk, in color, of New York's super-modern International Airport. Since this was a shot requiring a helicopter, it was necessary to use a minimum of equipment and take advantage of the remaining daylight plus the floodlights, with the added problem of stopping motion at a comparatively slow speed due to the low light level. Finally, there is a pure available light shot, in this case of fairly high intensity. Here, the problem was not so much the amount of light but getting proper color balance without losing too much film speed since the wide-angle lens used had a maximum aperture of f/4.5. Obviously, these are not impossible problems. If they were, there would be nothing to show here, but they do show how, with no more than normal equipment found in virtually any photo section, some better-than-average photographers handled the problem of the big shot.

Waiting Room, Newark Airport

New York International Airport

Customs Area, International Airport

ASSIGNMENT

Make a color transparency of the interior of the Terminal Building at Newark Airport, giving an overall view of the main floor. The picture should include some of the diversified activities of the passengers there—checking in, waiting for arrivals, etc. There should be an air of immediacy.

PROBLEM

The problem involved getting enough light to permit a small lens opening which would give enough depth of field to cover the 455-ft.-long room. Were we to use a 4 x 5, this would mean a maximum aperture of f/11, requiring 118 No. 50-B bulbs with E-1 Ektachrome. Daylight-type film had to be used because during hours of greatest passenger activity, daylight came through the glass walls of the enclosed observation deck to illuminate the waiting room.

SOLUTION

Using two Rolleiflexes mounted side-by-side on the roof of the ticket offices, we found that the nearest object was 30 ft. away, so that f/5.6 focused at 80 ft., gave us the needed depth of field, from 30 ft. to infinity. With E-2 Ektachrome, we could use a guide number of 220 for 50-B bulbs in 12-in. reflectors.

The lighting set-up used twelve such reflectors, equally spaced along the sides of the room and wired in parallel on a 120-volt line with a pear switch at the camera. Two broad pan reflectors, each with three bulbs, were used at the far end of the terminal, feathered to eliminate hot spots and reduce falling off of the light.

One Rollei was set at the estimated correct exposure, f/5.6, and the other camera ⅓ of a stop over about f/4.5. At 4:20 p.m., the level of daylight dropped enough to permit open flash. A slide from an 8 x 10 holder was placed in front of both cameras and the shutter locked open with a locking cable release. The slide was removed, the switch pressed and the slide replaced. Since No. 50-B bulbs give virtually all their light within 40 milliseconds, the open flash exposure, for all practical purposes, was 1/25.

The cameras were reloaded and this time, one was set ⅓ under, about f/6.3 so that we had four rolls; two normally exposed, one ⅓ over and one ⅓ under, all exposure bracketed within ⅓ of a stop. One normal roll was processed as a control and proved good, the f/5.6 exposure being correct. The other normal roll was also processed, but not the two under- and over-exposed rolls since we already had the picture we needed.

ASSIGNMENT

Make a color picture of the New York International Airport at dusk, showing the International Arrival Building and the Airline Wing buildings as well as the adjacent pools and fountains. An aerial view is desired.

PROBLEM

The problem revolved about the methods of getting enough light, good color and maximum sharpness while photographing the eleven-block-long building at dusk from a moving aircraft.

SOLUTION

The terminal area is brightly lit by high intensity floodlights mounted on towers, making possible an exposure of 1/15 at f/1.5 on Super Anscochrome. Using a one-stop push would allow 1/30 for increased sharpness. The shot would have to be made when there was a balance between daylight and flood light, so that we could get more detail in the shadows.

We set up a 35mm camera on the roof of an airport building. Starting at 20 minutes after sunset, exposures of f/1.5 at 1/30 were made at one-minute intervals until dark. The results indicated that this balance would last about five minutes. Other desirable conditions were a clear sky, no clouds, and winds of eight to ten knots. We would be using a helicopter which would create too much vibration for sharp pictures if it hovered. Instead, we would travel at an air speed of about 20 knots; a ten knot head wind would cut our ground speed and reduce the amount of movement. With 1/30 sec., the amount of movement in a picture can be critical. To further reduce motion, the pictures would be made while crabbing in toward the terminal, so that all motion would be toward the camera instead of across the field of view.

Two weeks after tests were made, the weather bureau gave us an ideal weather prediction. Departing from LaGuardia, we arrived about ten minutes before proper light balance occurred. Several practice shots were made and final shooting began three minutes before the balance until about three minutes after. Two 20-exposure rolls were used, which yielded twelve satisfactory transparencies.

ASSIGNMENT

Make color transparencies of various areas at International Airport including the Customs Inspection Area. The picture should show three walls, giving an over-all view of this section.

PROBLEM

The customs area is isolated by glass walls so that any shot would have to be made from the glass-enclosed gallery which overlooks inspection area. There was no place to put the necessary floodlights, nor any method for concealing the wiring. The entire building is lighted by fluorescent lights from a translucent suspended ceiling.

SOLUTION

Since the fluorescent lights would register if open flash technique were used, the only possible way to use flash would be synchronization. Here too, the same problems of size and the physical isolation of the room precluded the use of flash. If special lighting could not be used, how would the flouresecent lighting affect color films?

With the difficulty of using added lights, the only solution possible was to use the fluorescent light for an "ambient light" color shot. Tests were made on all available roll films to find if the lighting could be balanced without too great a loss in speed as a result of using a filter pack. A color patch card and a grey scale were taped to the glass wall of the gallery and photographed. The most promising results were with Super Anscochrome daylight film.

Roll film was called for in this case because the camera to be used was a Superwide Hasselblad. It was easier to use than a view camera would be, yet gave a large enough picture for our purposes, which would not be the case with a 35.

Examination of the test results indicated that a more pleasing balance might be achieved by raising the color temperature of the source through a combination of light balancing filters. Test exposures were made again, this time with various Kodak 82 filters, using Super Anscochrome rated at 200. The most pleasing results came from two 82C filters, each of which raised the color temperature of the source about 400K in effect.

The camera was positioned so as to look almost directly down the aisle leading to the customs area exit. The lens was flush against the glass partition in order to eliminate any reflection from the glass. The exposure was 1/10 at f/5. A 30 x 30 dupe transparency was made and used in the Port Authority Exhibit at the Brussels Fair.

COLOR

COLOR ACCURACY? DREAMER!

LLOYD E. VARDEN

The manufacturers have stated repeatedly that color films are far from perfect in their ability to reproduce color accurately. Color film manufacturers apparently are not as well informed about the properties of their materials as users. At least this is the impression one gains when talking to some photographers, and not only amateur photographers. How many times have you heard photographers refer to their color transparencies as being exactly the same in color as the original scene? This could be approximated only for a very restricted range of especially selected colors, uniformly illuminated and photographed to the same size.

The manufacturers sometimes imply in their consumer advertising that their color products are more nearly perfect than they are by using such words as "natural," "true," etc., in describing the results they produce. But in their more serious bulletins and technical data books the inherent reproduction errors in their color processes are by no means glossed over. They say specifically that photographic color materials are capable of giving visually pleasing color reproductions of scenes, but that exact reproduction should not be expected. In any simple sense, an objectively accurate color photograph of an ordinary scene is impossible, and I'll tell you why.

A TEST MAY BE A REVELATION

Probably the main reason that so many photographers believe in the reproduction accuracy of color films is the fact that side-by-side comparisons of the original colors and their reproductions are seldom made. Such comparisons are indeed revealing, and sometimes shocking. In all fairness, though, it must be said that some color materials reproduce certain colors amazingly well and nearly all naturally occurring colors sufficiently well to convince most observers that the reproduction is faithful. Problems arise in industrial and scientific photography only when color materials are misapplied, i.e., put to uses that require a degree of precision far more demanding than the material can meet.

How to do it

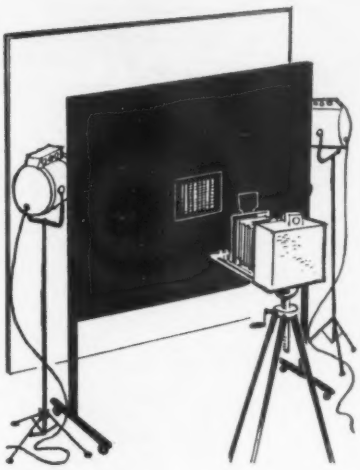
A good way to convince yourself of the limitations of color films is to perform the following test.

Prepare by hand a 3¼-in. x 4-in. lantern slide consisting of narrow strips of gelatin color compensating filters, including yellow, magenta and cyan, plus blue, green and red. The CC50 filters can be used in each case. Also include strips of the Wratten tricolor separation filters Nos. 47B, 58(B), and 25(A)—or better yet, Nos. 29, 61 and 49, in addition to a small film grey scale. This makes ten strips in all. If each is cut ¼ in. wide and 2 in. long they will fit nicely in the central portion of a 3¼-in. x 4-in. slide cover glass. The rest of the slide should be made opaque with black paper or tape.

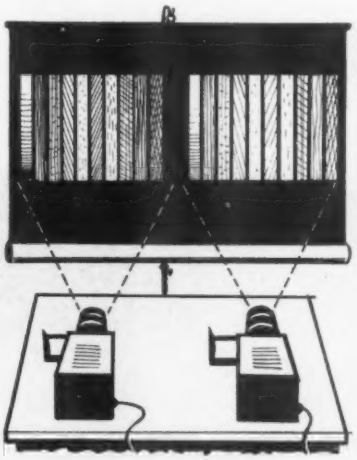
The hand-prepared slide is now transilluminated with a 3200K light source. A sheet of opal glass between the source and the slide will assure even illumination. Photographs made of this test object to the same size on 3200K Ektachrome and Anscochrome films can be bound between cover glasses to make slides for comparison against the original. In making this comparison it is better to project the slides side by side, but if two projectors are not available, the slides can be shown successively.

What happens

If the color films used are in good balance and the processing of them is everything it should be, the grey scale will reproduce rather well, although its contrast in the reproduction may be somewhat steeper. than in the original. However, the brightness and saturation of the color strips in the reproduction will be degraded, and shifts in hue will be noted in some of the strips of the reproduction transparency.



THE TEST *(see layout at lower left)*, consists of photographing a target made with ¼-in. strips of gelatin color compensating filters, a grey scale and tri-color separation filters sandwiched between lantern slide glass. Camera is loaded with film in question, shot as above.



SIMULTANEOUS examination of original and reproduction provides direct reference, usually missing link in judgments of color reproduction. Similar test of negative-positive color would use opaque target—e.g., a print grey scale and a set of Kodak Color Control Patches.

THE OBSTACLES: QUIRKS & DYES

To fully expound the reasons behind the failure of color materials to give exact color reproduction would require a good-sized book. The subject is complex and cannot be discussed in terms of the characteristics of color materials alone. Purely practical problems that do not involve the color film come into the picture, and are not easily overcome. And, surprisingly, we human beings have some rather odd and inconsistent psychological quirks which indicate that perfect color reproduction would not satisfy our visual preference in many instances.

It is well known that exact color reproduction requires the observer of the reproduction to be adapted to the same illumination level to which he was adapted when viewing the original scene. But an outdoor scene may be illuminated at a level of several thousand lumens per square foot, whereas the reproduction, under most practical conditions, would be viewed at an illumination level of less than 100 lumens per square foot. As R.W.G. Hunt has pointed out, to correct for this situation a color film would have to distort the reproduction toward a higher degree of color saturation so that it would look the same as the original when viewed under practical conditions. However, all colors have a maximum saturation and some red, orange and yellow colors exist in nature at this maximum. Therefore, the color reproduction could not have saturations higher than the maximum saturations of these colors, although such an impossible requirement appears to be necessary for exact color reproduction when the adaptation level changes in the direction already mentioned.

Undoubtedly there would be many industrial and scientific applications for color films capable of exact color reproduction. This would require (for one thing) that the emulsion sensitivities of the color film act identical to the sensitivities of the color receptors in the human eye. No color product meets this requirement, and the outlook that a technical feat of this magnitude can ever be accomplished is not hopeful.

Another fundamental requirement which has not been met concerns the absorption characteristics of the dyes formed in a color material. The dyes in proper concentrations would have to absorb light in such a way that the spectral characteristics of any color photographed could be exactly duplicated. The dyes formed in color materials have been considerably improved over the years, but the gap between the best existing dyes and the ideal dyes probably will not be closed for many, many years.

I have mentioned that a perfect color reproduction process would likely be unacceptable because of psychological reasons. There is more to this than one might imagine. For example, D. L. MacAdam of

MARILYN: KEEP A GOOD GIRL DOWN?

Kodak tells the story about Renoir when he was asked how he obtained such delicate flesh tones in the nudes for which he is famous. Renoir is said to have replied, "I just keep painting and painting until I feel like pinching, then I know it's right."

Now Renoir's renderings of flesh colors never were an exact reproduction of his model's flesh. And MacAdam has found that in photographic color prints an exact reproduction of flesh is considered too reddish by observers. On the other hand, in color transparencies this is not objected to.

The extents to which deviations from exact color reproduction are preferred (or tolerated) depend not only upon the specific nature of a color but also upon the object with which the color is identified. Consider a color photograph of Marilyn Monroe. It is amazing how eagerly people (male people) accept such prints from the waste barrel of a color print firm without any criticism of the color reproduction of the original.

There is some possibility, according to Hunt, that we have become so accustomed to colors being desaturated in reproductions that when more exact reproduction is approached the colors appear too highly saturated. MacAdam found that the most preferred flesh colors in color prints are less saturated than actual flesh colors.

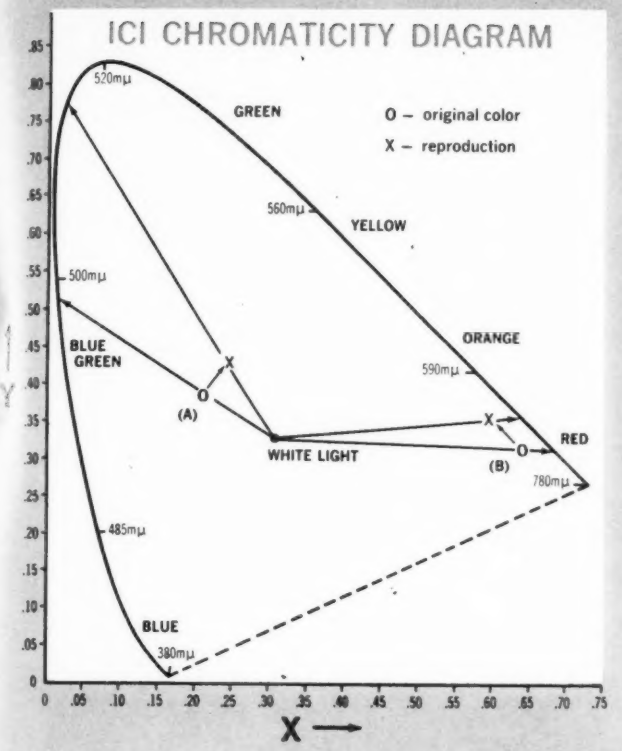
The best practical illuminant for viewing color prints or transparencies has not been agreed upon. Ideally the reproduction should be evaluated under the same type of illumination as used for taking the color photograph. But this is hardly feasible in general practice, considering the many different types of light source employed in photography. But the sins committed in viewing color reproductions, even by those who consider exact color reproduction possible and always desirable, are blots upon the technical competence level to which we like to think industrial photographers have risen.

Because of the unsettled conditions now existing as to the best compromise for a standard illuminant in photographic color viewers, etc., I shall not go into the subject here. But it is important to remind photographers that the color and luminance characteristics of the viewing source have a great bearing upon the appearance of color reproduction. It is not uncommon for color transparencies to be exposed under tungsten illumination, color prints produced from them under bright bluish fluorescent light and finally viewed by customers in a room dimly illuminated by a mixture of tungsten light and daylight. In such a chain of events it is understandable that differences of opinion should arise among the photographer, the color print producer and the final consumer.

Recommendations

In my opinion industrial photographers should not accept any

(*continued on page 69*)



COLOR	ORIGINAL			REPRODUCTION		
	X	Y	lightness %	X	Y	lightness %
Blue-violet	0.353	0.255	4.6	0.413	0.388	0.83
Blue	.325	.295	8.1	.363	.393	1.13
Blue-green	.217	.379	12.1	.248	.417	2.0
Blue-green	.235	.489	9.9	.299	.473	0.54
Green	.358	.554	18.8	.387	.530	0.47
Green	.451	.527	25.3	.445	.506	1.52
Yellow-green	.472	.491	33.2	.498	.474	2.61
Yellow	.555	.435	47.2	.568	.428	7.8
Orange	.640	.359	33.8	.616	.384	3.65
Orange-red	.662	.337	24.4	.640	.360	2.7
Red	.652	.325	21.8	.634	.368	3.4
Magenta	.604	.270	14.9	.591	.350	3.43

FAILURE STORY

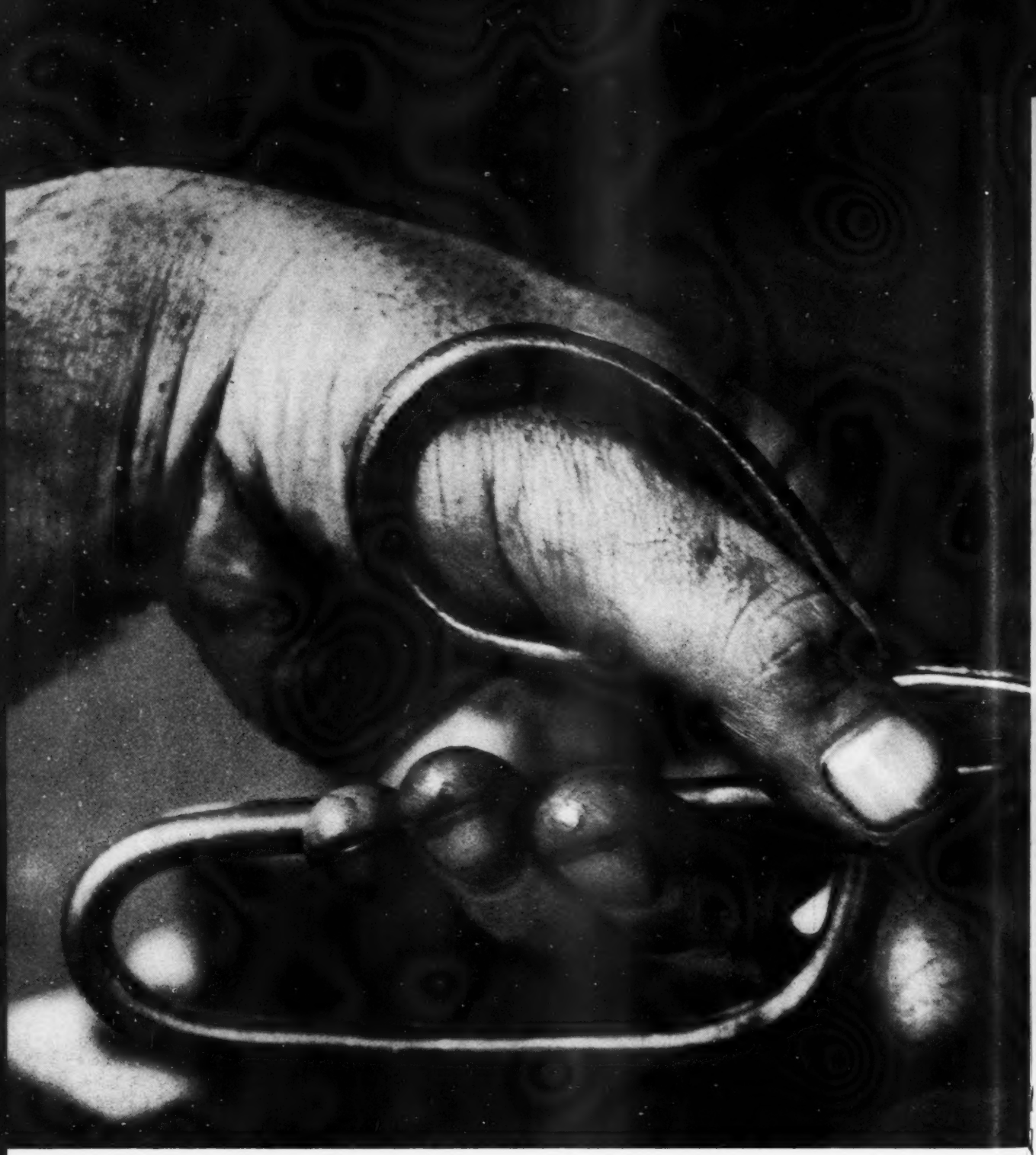
A useful method for specifying the chromatic characteristics of a color is by locating the position of the color on the chromaticity diagram *(left)*. The solid line represents the spectral colors from blue-violet to deep red wavelengths. The dotted line represents purple colors that are not contained in the spectrum. A typical white light source (daylight) is plotted near the center of the diagram as a solid dot. All normally seen colors fall on the solid or dotted lines or within the area which these lines enclose. The general hue that a color has is determined from the diagram by drawing a straight line from the white point through the point locating the color to the spectral locus. This point on the spectral locus is known as the dominant wavelength of the color. The closer a color is to the spectral locus, relative to its distance from the white point, the higher its purity. At the white point the purity is zero. At the spectral locus it is 100 per cent. ("Color saturation" can be considered equivalent to purity, except in a specialized sense.)

If an original color and the reproduction of this color are both located on the chromaticity diagram certain information can be obtained about the accuracy of reproduction. Two examples from the table are plotted on the diagram left. The original colors are shown as circles and the reproductions as crosses. The blue-green color of example A reproduced more greenish than in the original and the red color in example B reproduced more orange. Lightness values are determined separately and given along with the x, y values as a complete specification of a color.

The x and y trichromatic coefficients and the lightness values are given, left, for twelve different original colors and for their reproductions on a modern reversal color film. These were taken from a paper by M. E. Clarkson and T. Vickerstaff published in *The Photographic Journal*, Vol. 88B, pages 26-39. The trichromatic coefficients are determined from the tristimulus values with these formulas:

$$x=X\div(X+Y+Z);\ y=Y\div(X+Y+Z);\ z=Z\div(X+Y+Z).$$

The tristimulus values, X, Y and Z represent the amounts of the primary stimuli required to match a color. Instead of using these values directly, the trichromatic coefficients are used since these are defined so that $x+y+z=1.0$. Therefore the value of z is dependent on the values of x and y, so only x and y are necessary for plotting the chromaticity of a color. You will note from this table that the reproductions suffered consistently in greatly reduced lightness characteristics compared to the original colors. Many color films tend to give increased contrast also. The difference in the x, y values for the original colors and reproduction show that none of the colors reproduced exactly. When these values are plotted on a chromaticity diagram it is easier to evalute the shifts in hue and changes in purity that occurred in the reproductions. These particular data show that the reddish and magenta colors became more orange (or yellower) in the reproductions, the greens more yellow and the blue-greens more green. The deep blues reproduced greyer, or less saturated.



A worker's hand clasps a pair of tongs with which he feeds metal into a forming press. Part of a series for *Today*, International Harvester employee magazine, McDougall shot with a Rollei, 1/10 sec. on Tri-X at f/4 by shop light. Another *Today* picture *(right)* is a portrait of a retired IH worker in his greenhouse. While the man was engaged in conversation, McDougall photographed him from all angles—"Shoot enough and they forget you're taking pictures"—with the Rollei. Corn comparison *(right, above)* is an illustration for *Harvester World*, which goes to the public. A farmer-subject suggested idea. McDougall executed it in studio with Linhof, to show greater length of kernels on top cob.

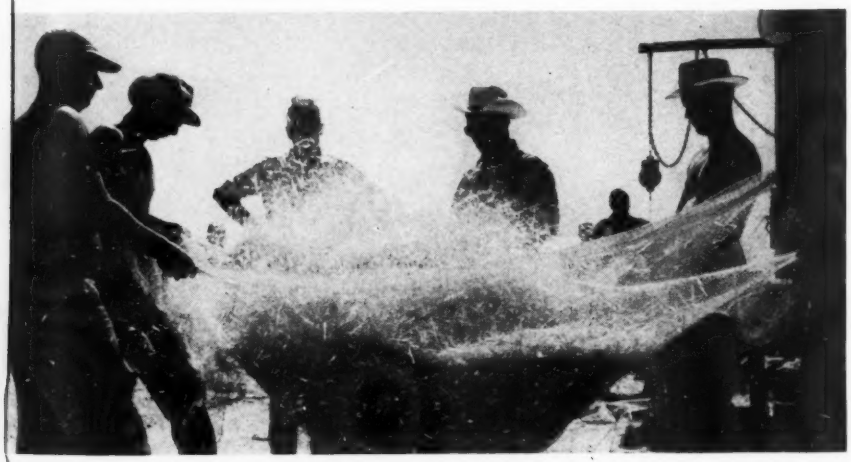
After six years of high school teaching, Angus McDougall turned in his resignation to the Wisconsin Rapids, Wis., School Board, packed up his wife and kids and left for New York City to enroll in a photography school. This decision did not meet with unanimous approval in all quarters. His parents saw him off with three words of comment: "You are crazy!"

He had made up his mind that photography was the career for him when the high school lent him a 2¼ x 3¼ Speed Graphic. The Milwaukee *Journal* bought some of his free lance pictures and thereafter, he says, "I never let that camera out of my hands."

With photo school under his belt, McDougall landed a full-time job on the *Journal*, took news, sports, color, roto pictures for nine years. He left to become the photographer for *Harvester World* and *Today*, International Harvester Public Relations magazines in Chicago. He's never been happier: "Now I'm in on the say about what to cover." His sanity is intact despite his addiction to photography.

PORTFOLIO NO.15

In a story on Wisconsin Steel for *Today* McDougall had the sort of opportunity to engage his talent in a way that newspaper work never offered. Over two weeks' shooting, he exposed 1,000 to 1,200 frames, had his run of the plant and knew that once done the story would be fitted around the pictures and not vice versa. McDougall used 35mm Tri-X for the series. About 90 per cent of his work is done with 35mm equipment, namely five Nikons he owns and rents to the company with a flock of lenses. One of McDougall's pictures *(below)* shows a blast furnace keeper and his helper at work.



Gunfire signals the start of a field test to determine the efficiency of an International Harvester McCormick combine (combined reaper - threshing machine). In the test, IH men gather straw and chaff in a blanket for a specified period of time as it comes out of the combine. Following this, they carefully hand-thresh the chaff to determine exactly how much of the grain the combine has missed. McDougall traveled from Chicago to California to photograph the test on the first crop of the season in Imperial Valley. He had one try. As is his practice, he hung two Nikons around his neck—"so I won't run out of film; but both cameras always run out of film at the same time anyway"—and shot like mad. He managed to squeeze in 70 frames of the event on two rolls of Plus-X, his daylight standard.

COLOR

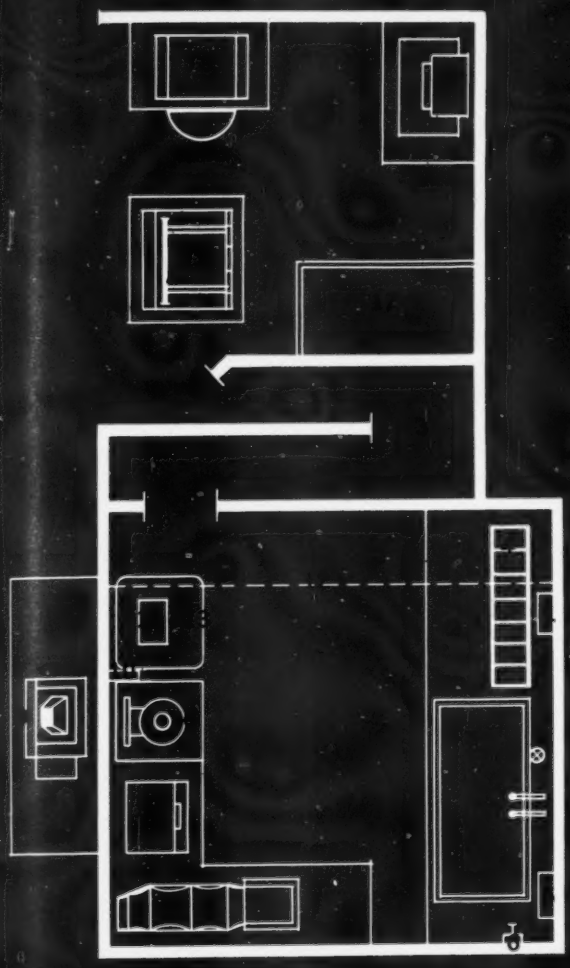
ONE-MAN COLOR LAB

Charles Woodward was an old pro at color, but he didn't think he'd be a pioneer when he stepped into photography at the Metallographic Section of Sperry Gyroscope. Here's how he manages his 12 x 12 ft. color print lab with a head, two eyes, two hands, professional but unfancy equipment, and a generous supply of color critics—Photo Department Analysis No. 15

Charles C. Woodward broke into industrial work four years ago thinking he knew just about all that a color photographer needs to know. He had been a commercial man, then switched to color finishing and worked his way up to final inspector in a Kodak processing station. His record looked good, so Frank Vandeveer, chief metallurgist of Sperry Gyroscope in Great Neck, N.Y., hired him.

Then the bombshell. Sperry needed color photomicrographs of metals for reports from the materials laboratory, of which the metallurgical section is part, but they didn't want transparencies. They wanted color prints. And they wanted the color prints to duplicate, for all practical purposes, what one sees of metal specimens through the eyepieces of microscopes and metallographs.

Tripack prints from transparencies? No dice. Dye Transfers? Maybe, but the work load would call for Woodward to turn out two dozen prints from four negatives in a morning. Just as Woodward was beginning to think that maybe there's a better way to make a living than color metallography—he remembered some gossip about a new color print material at his former employer's. He called a salesman friend. "Oh, yes. Type C, be just what you need. Ought to be released in four or five months," said the salesman. Woodward moaned, "If I wait four or five months, I'll be out of a job. I need it now!" The salesman arranged



COLOR PHOTO LABORATORY

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

for Sperry to field test the new color-negative color-print material via Woodward. He got a quick course in metallography from Sperry and in Type C printing from Kodak. He then produced his first Type C illustration.

Sperry metallurgists were impressed, Woodward's boss was pleased with his choice of man, and Woodward began breathing again.

As things turned out, the numerical majority of Woodward's 200 or so photographs in a working week are not color jogs at all, but rather monochromes. Where color is used, it is as essential to the meaning of the picture as color vision is to a railroad engineer. Woodward shows a set of pictures to illustrate the point. One is a black-and-white ultra-close-up of soldered wiring. It looks simply like soldered wiring. A second shot, this one in color, of the same subject reveals why the picture was made; parts of the wire are flaking into a bluish scale. Sperry was out to beat the scale.

Why color photography?

In metallography, says Woodward, color is particularly useful for recording the colors of metals in the form of plating, picturing colored inclusions in metals, photographing oxidation products, showing phase changes with special etching techniques and displaying the looks of metals viewed by polarized light.

The picture-making equipment in the Sperry metallographic photo lab consists of a Bausch & Lomb Photomicrographic camera equipped with a variety of macro-lenses and microscopes, a Grover view camera and a metallograph. Since the specialized equipment takes 5 x 7 format film, Woodward has standardized on this size for his color work.

Much of Woodward's shooting time is spent hovering over the focusing screen of a Vickers Metallograph. This device, which rests on a table outside Woodward's lab, is about the size of a Model A Ford motor, with as many appurtenances. Woodward assures visitors that it is essentially a microscope turned upside down and adapted to high-magnification of metal specimens. One of the modifications is the light source. It is a carbon arc whose output is reflected and refracted until it travels to a half-silvered mirror. The mirror is between the two lenses of the microscope. It reflects about half of the incident light to the stage, containing a sample of metal. The metal reflects the light back through the microscope, through the unsilvered portions of the mirror et al, and finally to the eye of the operator, or alternatively, to a

photographic film or plate holder in the camera.

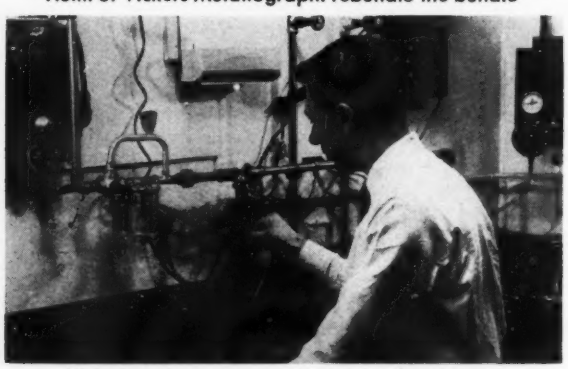
A metallurgist prepares the specimen and operates the machine until he derives the information he is after; then he calls in Woodward. Woodward's job is to render on color film the clearest possible interpretation of whatever is important to the metallurgist. The means of control are somewhat limited, but Woodward is able to filter the light beam (a 2B filter is interposed in the system regularly to absorb ultra-violet radiation, and color compensating filters are used to suit the requirements of the picture). There are also two iris diaphragms in the path of the light from the arc to the microscope. By varying these, Woodward is able to adjust the bundle of light rays reaching the specimen and effect a considerable change in the apparent sharpness of the image. He has found that experience is the most reliable guide to the proper exposure of his material, 5 x 7 film, usually Ektacolor.

Woodward's laboratory is by no means the only photographic installation at Sperry. "Last time I made a personal count there were twenty darkrooms scattered around the place," he says. But it is the only in-plant color processing station. It is set up to provide for the needs of the metallographic section and it is limited, for the most part, to its service.

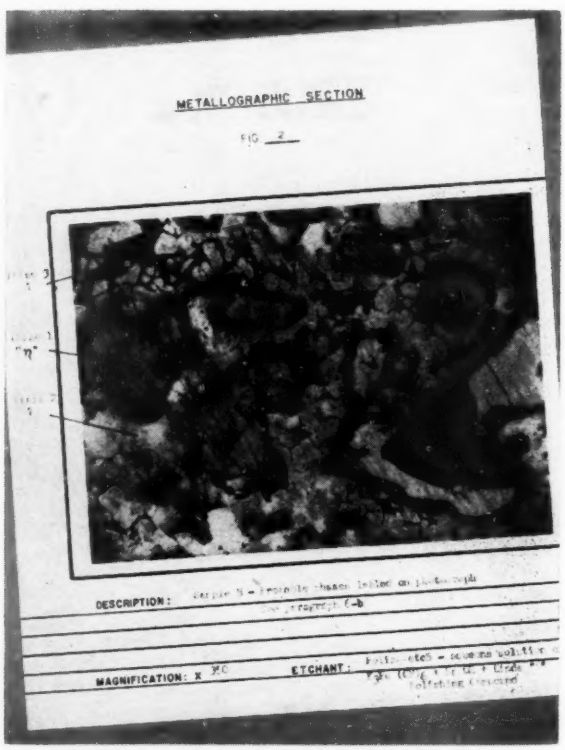
"It is not a production type facility," says Woodward, who converted it from a "collection of antique furniture and antiquated photo stuff" into an efficient 12 x 12-ft. one-man color and black-and-white darkroom. He explains that the amount of production is not the main criterion for the success or failure of the lab. The point in making metallographic illustrations in color is to illustrate metallographic facts. "Metallurgists are pretty severe critics of color quality," Woodward adds, and, while there's no complicated hocus-pocus to getting good color print technical illustrations, the work does require careful processing control and individual treatment of each subject.

Woodward processes his color negative material and transparency film in a stainless steel water jacket with 1-gal. inserts, for which he has designed and made a nitrogen gas distributor. Unless he knows that he will need solutions again in short order, Woodward discards the processing kit after a single use. The consistency of the results, he feels, more than repays the cost of fresh chemicals.

Helm of Vickers Metallograph: rebundle the bundle

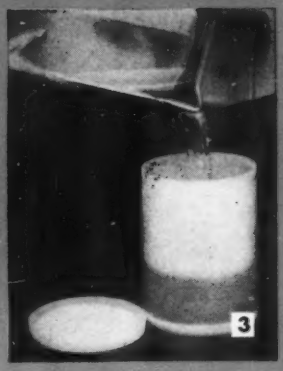


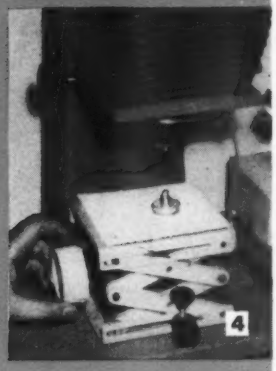
Negative processing: use it once and cast it out



Metallographic report in color: 24 in a morning

IN A SCIENTIFIC LABORATORY THE PHOTOGRAPHER CAN LIVE A LITTLE





1. QUICK MIX lab device is stand containing spinning magnet. Beaker rests on stand. Metal bar coated with resilient material is dropped in beaker. Bar spins, mixes color solutions fast. Called Mag-Mix.

2. BURST TO ORDER Woodward could not find a nitrogen gas distributor to fit his 1-gal. tanks. He made this one of quarter-in. I.D. stainless steel tubing. Silver solder fastened joints in the tubing.

3. ANNULS FUNNELS Because he uses only three trays for Ektacolor paper processing, Woodward dumps them quickly into these wedge-capped poly cylinders made by Scientific Glass Apparatus Co.

4. LAB JACK is another device borrowed from industrial laboratory practice. It puts lights, or subject, at exactly right height for photomacrographs. Scientific supply houses handle mixer, cylinders, jack.

The lab is equipped with a tempered water system, and an outlet for nitrogen gas. Other sections of the Materials Laboratory use nitrogen in tests and experiments, so he is relieved of having to import bottles of the stuff for agitation. Woodward counts as necessary this equipment—as well as a refrigerator for film and paper storage—in producing color work to meet the demands of metallographic applications.

Because of the large format of the negatives, Woodward standardizes on contact color prints. He makes them on an old-fashioned contact frame, by the light of an Omega D2 enlarger with a color filter drawer.

Special equipment for color printing consists of a Sola Constant Voltage Regulator and a Photovolt Color Meter. The meter is used to balance the color of the light coming through the enlarger and to estimate the length of exposure with any particular filter pack. (He stocks two sets of the yellow, a set each of the magenta and cyan color compensating filters.) When making prints, Woodward first selects a typical negative from the batch and exposes it according to the information he derives with the color meter. He processes it in the usual way, except for doubling the duration of time it's in the hardening bath. When finished with the processing cycle, he dries it on his Electrogloss drier with the heat cut down below what he'd use for finishing black-and-white prints. Only when dry can he inspect the test. If it's okay he completes the series of negatives, using his judgment as to additional corrections. If it's far off—it's usually not, he says—he makes another test.

Because the set-up time is so great compared to the time for making extra prints, Woodward usually anticipates re-orders when making color prints. More prints are almost invariably re-ordered.

Quick change artist

The space in Woodward's darkroom limits him to the use of only three trays for processing Ektacolor prints. No harm, he says. Woodward has acquired a set of wide-mouth polyethylene bottles (*see illustration, above*) one for each of the chemicals in the Ektacolor processing kit. Before he sets up, he puts the bottles in the sink, into which he runs properly tempered water. The first three solutions go into the trays, and he commences processing (in the dark). At the end of the third step, he flips on the light, quickly dumps the third solution into the wide-mouth bottle and carries on the remainder of the processing steps with a single tray.—THE END

COLOR

ELECTRONIC FLASH TECHNIQUE

Color with electronic flash, as with other light sources, can be as simple or as complicated as one cares to make it; sometimes the most complex methods give the most expensive, but least desirable, results.

No color is any better than the manner in which it is reproduced for the eye of the ultimate viewer. It is foolish, expensive, unrealistic and academic to be overly exacting about the accuracy of color transparencies when there is no control of the color and intensity of the viewing light, or when the paper, ink and printing method do not permit faithful reproduction.

The skill of the photographer lies not in his ability to record a scene exactly, but to record it well enough for the purpose at hand. Careful consideration of what is important and what is not, is an essential step in the making of any color shot.

Work within limitations

If we are willing to work within the limitations of the materials *and* the light sources, electronic flash is indeed a valuable tool for studio or in-plant photography. This is not only because it stops action, but because it is cool, consistent, quick and cheap.

Small portables equipped with phototube "slave" triggers can produce an elegant result right out in the shop with a minimum of fuss or confusion.

With large areas, flashbulbs may be the practical solution. Speedlights can be heavy and cumbersome. Walter Farynk of GM Photographic commented: "I draw the line when I begin to leave my footprints in the concrete. Flashbulbs are often quicker and easier."

Let's review the factors that influence the results of any color shot and see in what way they apply to electronic flash.

The color temperatures of speedlights range somewhere between 6,000 and 7,000K. Since this approximates the color temperature of daylight, daylight films are normally used.

Results seem to vary greatly with film which has aged or has been exposed to undue heat or humidity, or to fumes, or gases, even if their emulsion is of the same batch. There is considerable loss of contrast, distortion of balance and increase in reciprocity failure.

Variations from emulsion to emulsion can be properly allowed for by following the manufacturer's recommendation as to color correction and emulsion speed. It's a wise color photographer who consults the data sheet packed in each box.

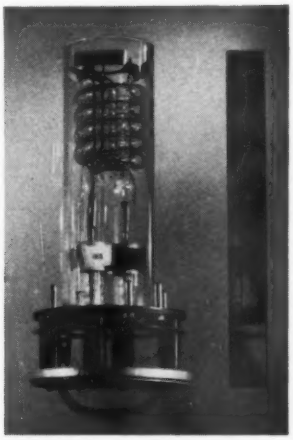
Users play no favorites

In questioning a number of outstanding users of electronic flash of all types, there seemed to be no unanimity in favor of a particular type or brand of film, so far as its suitability for speedlight is concerned. Preference was governed almost entirely by other factors.

Amazingly enough, very few photographers use filters with their electronic flash. Comments range from "We haven't used a filter in years," by the Milwaukee *Journal's* Elmer Staab, to "We use only the emulsion correction filter," by Ford Motors' Bob Boram. Noteworthy exception is the *National Geographic*, where filters are always used in studio work. Copying of art objects and paintings was cited as the principal reason for their use. Mike Durante of Allis Chalmers uses Kodacolor without a filter because he gains that much more speed. He warns that it's important to indicate to the processor that Kodacolor was shot with speedlight and that the indoor shots are to be treated as "daylight" exposures. Jim Lowe of the Color Darkroom Studio in Milwaukee prefers to print Kodacolor speedlight taken without a filter. He feels it's easier to work with because it's redder and brighter and the exporsures are shorter.

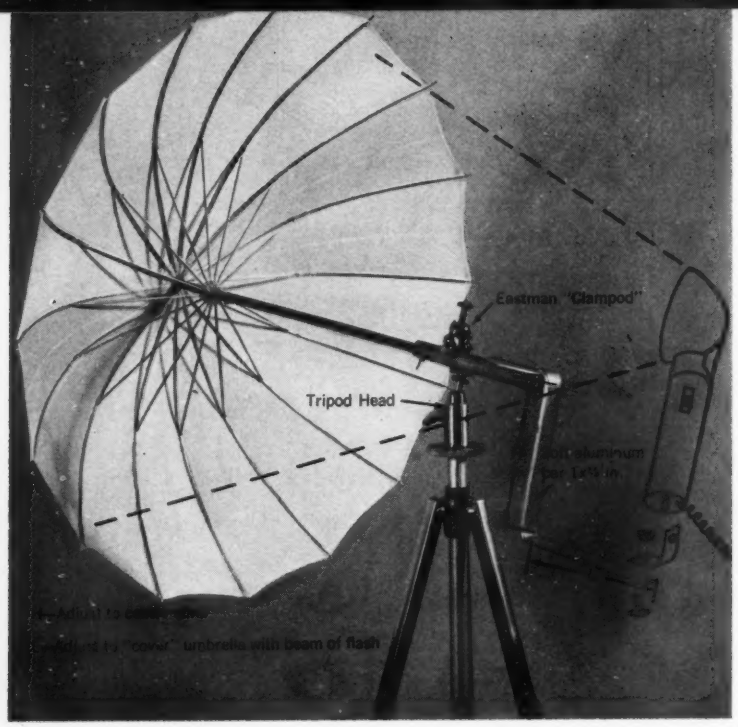
Another processor, Ulric Meisel, Meisel Photochrome Corp. in Dallas, Tex., takes a different view: "I can only state that it is best to follow the manufacturer's recommendations when exposing color negative materials to electronic flash. True, you may be able to obtain acceptable prints from unfiltered negatives in most cases—provided your exposures fall right on the straight line portion of the characteristic curve. But when you overexpose and happen to be using an emulsion with a cyan bias

How fussy do you have to be in shooting color electronic flash? What's the easiest way to get predictable, consistent results? What causes most color failures with electronic flash? Are electronic flash exposure meters any good? What can you make and do to get better color condition? Are filters necessary? PMI's electronic flash expert, Edward R. Farber, reports the facts, figures, current practices and controversies on a color light source that is fast, light, bright, cheap and cool. In fact, for most purposes, it has everything.



For the big picture: G.E.'s FT-617 flashtube

The picture on the left is an aerial reconnaissance photo made at night which illustrates the covering power of the largest General Electric flashtube now available, the FT-617 *(above)*, capable of providing sufficient illumination for photography at two miles' distance. Says GE, "Accompanying each flash is a distinct and startling 'pop!' caused by the sudden expansion (caused by heat from the bulb) of surrounding air . . . heat from the flash is so intense that it chars wood at a distance of a foot or so from the tube."



A soft, portable light for color

A simple device, which you can build at little cost and carry along wherever you go, requires no more space than an average light stand. It converts your electronic flash head to a "skylight" that provides a diffuse light with excellent modeling, and eliminates dense shadows (see before and after comparison, *above*) whether you take color photographs in an office or a coal mine.

Here's how you can make it: 1. Go shopping. Find an umbrella sale. Pick out a white job, preferably made of nylon or other synthetic fabric which will not discolor easily. Try for a wood shaft too, because it is easier to work with. **2.** Cut off the existing fancy plastic handle. **3.** Dig through your scrap box for suitable hardware. *(See illustration for materials used to make unit shown.)* **4.** Attach flash head to handle end of shaft, centering the reflector within the circle of the open umbrella. Extend length of handle if necessary to insure beam from flash covering entire circle of fabric. *Unit shown was made for use with Braun Automatic flash.*

Here's how you can use it: 1. Use as reflector (flash unit pointed *away* from subject with light bounced from umbrella back to subject). Or use as diffuser with light unit pointed *toward* subject. Unit shown works best as parabolic reflector. **2.** Shoot series of test negatives each way to determine necessary alteration of flash guide number. Unit shown required increase of two stops used either way.—TOM MARTIN

(and there are quite a few of these around) you'll find yourself with a lovely cross-over pattern and wind up with prints showing cyan highlights and orange middle tones. So why not play it safe and use the No. 85 filter—or, if you are a non-conformist, you can try a No. 85B or 85C?"

Part of the explantion for the tendency to shoot without a filter may lie with the slight yellowish brown deposit that lines flashtubes as they age, particularly when heavy loadings are used. Gjon Mili, a pioneer in speedlight color, kept an accurate record of the number of flashes on his flashtubes used with 1,000-watt-seconds or more. He then changed filters according to a chart he had worked out from previous experience.

The cements in many older lenses have aged so that they impart a warm tone to speedlight shots, filtering out some of the blue. When these lenses are used with incandescent light, the effect can pass unnoticed.

Studio shutters are often slow. Therefore ambient incandescent light can give speedlight color an unsuspected warmth. Most diffusing sheets, white paints and papers furthermore tend to absorb some of the blue, so when bounce or diffusion is used, tones will be somewhat warmer than with direct light.

Lighting simple and elegant

A minimum of light sources is best. This is good advice, not only esthetically, to avoid the confusion and irritation of multiple shadows, but also because it is far easier to judge the lighting and estimate the exposure with simple lighting.

Most studio flash units are equipped with modeling lights of some sort. Sometimes the intensity of these can be easily changed so that the brilliancy is proportional to the watt-seconds connected to the flashtube. Because of the heat generated by incandescent lamps, the wattage of modeling lights located within the helix of the flashtube is limited and their brightness is inadequate for larger areas.

Electronic flash is not subject to as much control as incandescent illumination. Spotlights are an example. High output sources require large flashtubes. Speedlight spots

must therefore be large, inefficient and expensive. Best substitute is a polished parabolic reflector with a long snout to allow only the parallel rays to emerge. The further it is from the subject, the sharper and darker the shadows become.

Test all your reflectors by photographing a plane surface with each of them in color to determine their distribution pattern and to avoid trouble from unsuspected hot spots. (Remember that nearly all lenses distribute slightly less light at the corners of the frame than at the center, however.)

That old bounce

Bounce light techniques, dating from the turn of the century, (with arc lights), were picked up by early enterprising Kodachrome users to simplify lighting problems and give shadows with satisfactory color rendition. About the same time large tent-like structures were also borrowed from earlier black-and-white practice. These consisted of muslin stretched over frames with the lights shining through from the outside.

Then the Edgerton and Ascor "Sunlight" units came along. With them, a single flash of 10,000 or even 20,000-watt-seconds could be placed high in the studio and used without a reflector, to simulate sunlight. Reflecting surfaces fill in the shadows and provide proper modeling. Large venetian blinds are sometimes used for reflectors since the character and amount of reflection can be controlled by adjusting the blinds.

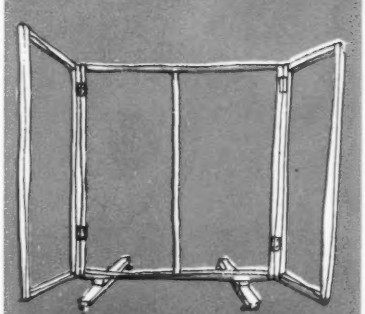
The large sunlight units are expensive and hardly portable, but permit studio sets to be exposed at f/16 with but a single source.

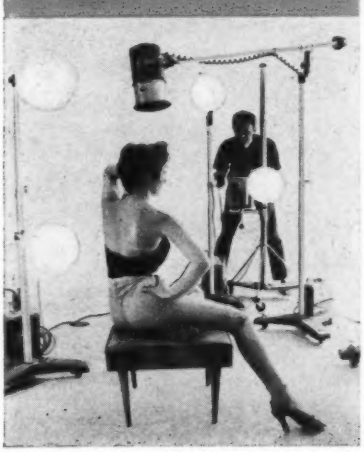
Meanwhile, the diffused light technique changed from putting the lights outside the tent to putting them inside. Small studios were painted dead white. White asphalt tile was sometimes used on the floors. Lights were bounced on the floors, walls and ceilings. Of course, very little light is absorbed in such a set-up and relatively small power packs can be used.

Some studios have made skylight sources by covering frames with chicken wire and laying diffusing sheets over it. Light sources are mounted a few feet behind.

White on white on white on white...

The de rigueur color photographer has taken to painting everything in sight matte white —floors and windows included. (See Peter Gowland *below* with his all-white set-up.) The system has four major advantages: 1) More total light reaches the subject. 2) Reflected light does not impart a spurious color to the subject. 3) You can bounce your lights against the handiest plane surface. 4) The level of light in shadow areas is raised. One worker, Dave Hecht of RCA, goes a step further with an 8 ft. high movable reflector wall *(diagram below)*. 4-ft., 8-ft., and 4-ft. wide sections are hinged together. Seamless paper is tacked to frame.





By far the most interesting of recent methods to get true sky lighting is a flash unit introduced by Milton Schwartz of New York City. This consists of a group of 20 reflectors arranged in a flat bank 4 x 5 ft., and operated from a 1,000-watt-second power pack. Twelve 75-watt reflector floods are mounted in-between the reflectors to provide 900 watts of incandescent light for modeling.

The white umbrella is another trick unfolded by photographers. The source is mounted on the handle and aimed into the umbrella to provide an effective and portable large-area source.

Light is temperamental

The intensity of the light falling on the subject being photographed by electronic flash depends principally on the energy storage in watt-seconds and the distribution pattern of the reflector, and to some extent on the length of cables, efficiency and loading of the flashtube.

Variations in line or battery voltage can cause variations in output of course.

Because the energy stored in electronic flash units is proportional to the square of the voltage, changes in supply voltage can be important in color work. Power packs which are equipped with voltmeters that read the high voltage help insure consistent results. Next best is a meter on the AC line. Voltage adjusters of adequate size can be used to keep the voltage at the required level.

Automatic voltage regulators are available, but test before you buy. Some such regulators distort the AC wave giving a flattened wave shape. This might give a 117-volt reading on an AC meter, but act like 100 volts to the flash unit which charges to the peak voltage of the AC wave. You can make such a check by measuring the high voltage on the capacitor or by viewing the wave form on an oscilloscope.

Most erratic exposures with flash units are the result of insufficient recycling time. The last 20 per cent of the charge takes twice the time of the first 80 per cent. Therefore it's good practice to wait three times the usual recycling time. Again a voltmeter is good

business. One voltmeter plugged into the high voltage of the slowest recycling unit will do if all units are operated from the same alternating current circuit.

Check line voltage

Voltmeters should be consulted frequently. Line voltages may be erratic. One photographer was puzzled for months by erratic results—only to find that when the elevator in their building was moving, the voltage dropped way down.

The part which reflectors play in determining guide numbers cannot be overemphasized. The efficiency of a reflector is dependent upon the size and shape of the reflector in relation to the size of the light source and the surface coating or finish of the reflector.

A highly polished reflector will concentrate the light much more than one with a satin finish though both may have the same size and shape. Thus two reflectors with the same size and shape might have a difference of five stops in exposure. Likewise, the area of coverage would vary by almost 100 degrees.

Guide numbers alone are relied on by so many successful speedlight workers that their use can be recommended as entirely practical.

Guide numbers have to be worked out for each reflector and possibly for different watt-second loadings of the same flashtubes. Flash duration becomes shorter with decreasing capacity. Cutting the capacitor bank in half will cut the duration by half, possibly bringing into play reciprocity failure, cutting effective exposure.

Guide numbers can be computed for other color films if you have established a guide number for one of them by use of the formula:

$$\frac{\text{Guide Number film A}}{\text{Guide Number film B}} = \sqrt{\frac{\text{Daylight Exp. index film A}}{\text{Daylight Exp. index film B}}}$$

But bear in mind the problem of emulsion correction filters and reciprocity failure of various emulsions which must be compensated.

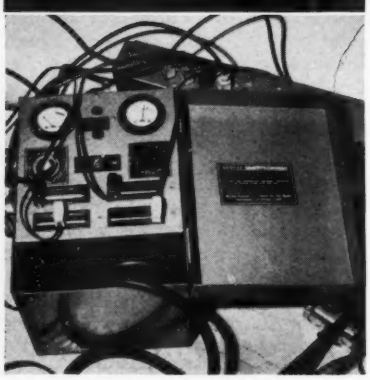
No matter what system of determining exposure is used in fact, reciprocity failure may play a part. Generally speaking when the number of capacitors connected to one flashtube is reduced the flash duration is reduced. (Duration is directly proportional to the capacity of the condensers measured in micro-farads.) To avoid the effects of reciprocity failure more exposure is often recommended at shorter exposure times. Ansco recommends, for example, a third stop additional exposure at 1/2,000 sec. for Anscochromes as opposed to 1/10 sec. exposure. The instructions packed with each emulsion batch should be consulted for filter and film speed corrections.

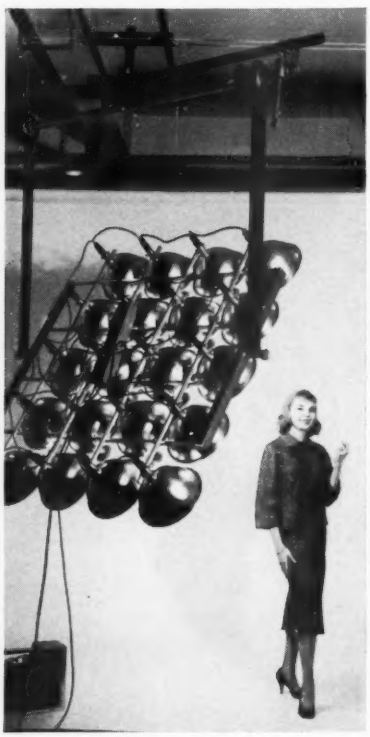
Standard exposure meters can be used to read the illumination of the modeling lights and these readings can in turn be translated into exposure. The big problems are these: The modeling lights may be too dim, or cannot be varied in proportion to the power fed to the flashtube. Modeling lights are frequently short-lived and subject to relatively great changes in light output over their useful life, so check them frequently at a fixed distance. Changes in line voltage will affect their output as well as that of the flash unit but not necessarily in proportion.

Many photographers work only from standard lighting set-ups. They know what f-stops to use from experience. Any new arrangements mean new tests.

Then there are those who prefer to use a black-and-white test to

(*continued on page* 68)





Pilots and floating skylights

Pilot light *(left, above)* nearly duplicates light direction of flashtube in reflector, is bright and may be swung away during exposure. It and skylight *(right)* are offered by Milton Schwartz, 225 E. 44th St., New York City. Skylight is mounted on overhead racks, glides to nearly every conceivable location in studio, also has pilots. Natural Lighting Corp.'s ColorTran unit can adjust pilots till they duplicate output ratio of their respective flashtubes; shown is Dave Hecht's set-up.

COLOR Cheering weary commuters at Grand Central will be Rockettes, enlarged 103×

ROCKETTE SHOOT

Shooting 36 Rockettes in color for Kodak looks great but it took a whole night plus 68,000 watt-seconds of electronic flash to get the picture.

Among practitioners of the more glamorous branches of photography, industrial photography is sometimes (mistakenly) called "the nuts and bolts" school. There are times, however, when the assignment calls for something much less mechanical and infinitely more interesting. This type of chore fell to Kodak's Robert Phillips (*behind camera*) who was sent to photograph the "Rockettes" for Kodak's Colorama display in Grand Central Station. Few subjects bear less resemblance to the proverbial nuts and bolts than the Rockettes, although their dancing is equally precise, but since a true industrial photographer is never daunted by the unfamiliar, undaunted Bob went to New York to get his picture.

The main problem was lighting, and the solution, supplied by American Speedlight Corporation, was 88 Ascor 800 units giving a combined output of 68,000 watt-seconds. According to Ascor president Harry Parker, this was "the greatest concentration of special electronic flash gear ever gathered in one location."

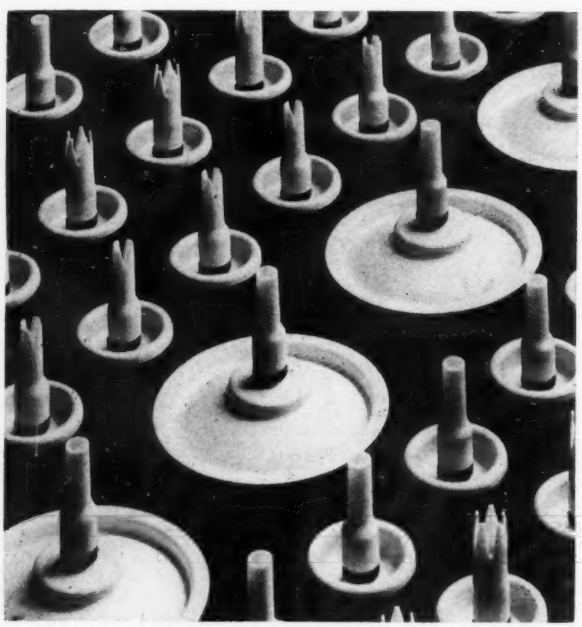
Music Hall electricians and stage hands placed the lights and backgrounds, with some of the crew acting as stand-ins for the Rockettes who spent the night in the theatre dormitory to be ready for the early-morning shooting.

A special Colorama Camera was used giving a 5 x 17-in. negative on 8 x 20-in. Ektacolor Type F film. The exposure was f/16.

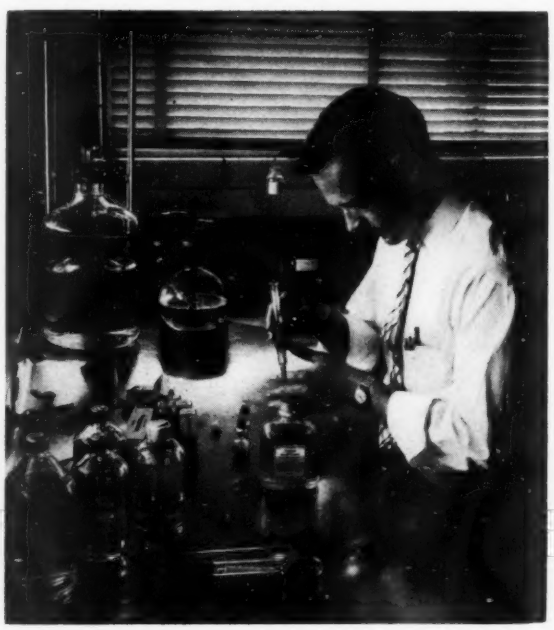
The negatives, developed in Rochester, were scaled into ½ by 5-in. sections, then were enlarged to 18 in. by 18 ft. prints. Forty of these strips were joined to get the final picture, 18 x 60 ft. During enlarging, the negative was mounted in glass for maximum cleanliness and ease of handling.

Weighing 75 lbs., the print was transported to New York on a special 20-ft. "Film Spool" which weighed 200 pounds. The installation, which will take five hours, will be September 30.

JOHN MULLER, New York freelance, used a K2 filter to get this dramatic picture of a Brooklyn Union Gas Company plant, thereby breathing life into what otherwise might be just another factory shot. He used a Graflex Super B 4 x 5, Royal Pan Film. Exposure was 1/50 at f/16.



ALBERT JAMES VAUGHN of Hunter-Grey Studios, Chicago, used a pattern arrangement to get a more interesting product picture. While not a new idea, it can be fairly effective if done as well as this photograph was. A Deardorff with a Commercial Ektar lens was used. The exposure, f/45 at 3 sec. on Royal Pan, gave essential sharpness.



EDWARD SCHUMM, of Upjohn's Photo Lab, did this picture for the Upjohn house organ, showing one of the tests used to determine compatibility of products. Use of available light preserved the atmosphere of the lab, giving this photograph its impact, at the same time dramatizing the need for constant care. He used Linhof, Royal Pan.

PMI's Monthly

READERS' SHOWCASE

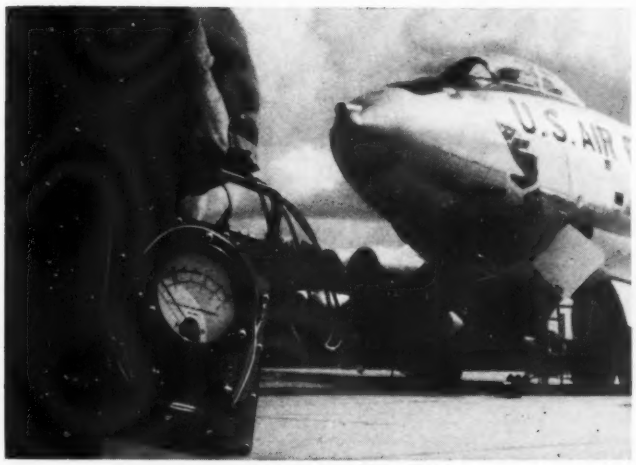
PMI's readers supply solutions to industrial photo problems

It is a great test of a photographer's skill when he can take a difficult subject and get a good picture, but it is even a greater test of skill when the cameraman has to take a fairly ordinary subject and come up with a picture which is not only interesting but seems to be a little different. This is what this month's photographers have done.

By using a filter and subduing the details of the gas plant, John Muller made a fine picture out of a subject which is almost a routine request, "get an over-all shot of the plant." Albert Vaughn found that while one subject is all right, making a pattern can make a picture. Using available light to convey the atmosphere of a testing lab made this picture for Edward Schumm. Try to imagine the same scene well lit, with all the details fighting for attention to see how lighting worked to lift this picture out of the routine category. Joe Farkas used many details to give him his picture of Ford workers, while Jerry Heller reduced his equally effective shot to just two points, the plane and the meter. These are all photographs where the man, not the subject, made the picture.

You are invited to send in your pictures for this feature. Here are the details.

There are two rewards for each of the pictures chosen. The first is knowing that your picture will be seen by appreciative fellow professionals. The second is $10. Please include your name and your company's name, a note about the picture and how it was used, with the technical data—paste the information on the back of each picture. Send pictures to SHOWCASE, PMI, 33 W. 60 St., N. Y. 23, N. Y.



JERRY HELLER of New York made this picture for the magazine of the Strategic Air Command, showing the importance of electronic equipment in the inspection and maintenance of SAC aircraft. The effectiveness of this picture would have been lost without the over-all sharpness, showing both the meter and the plane clearly. To get this, a 35mm Nikkor wide-angle lens was used on a Contax. Exposure was 1/250 sec. at f/11.

JOSEPH FARKAS, Ford Motor Company, Dearborn, made this picture, "Back to Work." This might be termed a "slow" picture, many small details holding the viewers' attention, compared to the immediate impact of, say, the gas plant picture. The eye travels along the mass of workers, picking out significant details. Made with a 4 x 5 Graphic on Royal Pan film, 1/100 at f/22.

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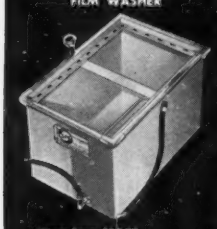

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by Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

A tentative report on High Speed Ektachrome; new bleaches for E-3

Last month we mentioned the Kodak announcement of the new High Speed Ektachrome (to be officially released in June). The facts stated in the column were gleaned from the Kodak press release and from some of the samples shown at the MPDFA show in Philadelphia. We now have some limited experience with the film to report. The following statements are not our final conclusions, however, because we have experimented with too few rolls.

As previously stated, the daylight film has an exposure index of 160. This rating was found to be accurate. Some tests were made by pushing the film one stop resulting in a "user index" of 320; the transparencies were quite pleasing. The extra time given in the first developer was an additional 4 min. (Kodak recommends an additional 3 min.)

With still more development we pushed the film to a speed of 600 with usable results; but Kodak will have none of this. One noticeably different characteristic of High Speed Ektachrome is that, unlike E-2 Ektachrome which goes magenta in color balance from pushing, this film seems to go greenish. We suspect that further manipulation of the color developer time can eventually compensate for this shift in color when the film is pushed to 600.

The grain structure of the film seems to be quite satisfactory for such a high speed film.

Tungsten e.i. 100

The tungsten film has an e.i. of 100 with 3200K lighting. With 3400K photofloods and an 81A filter the speed is reduced about 20 per cent. Converting the film to daylight with an 85B filter further reduces the speed to about e.i. 64. We have seen pictures taken with ordinary household tungsten light and thought that the color balance was pleasing even though a little on the warm side. We have not tried the daylight conversion of the film but we see no reason why it should not result in good transparencies.

As this film is processed at standard development times in the E-2 improved solutions, it is quite apparent that the speed is built into the film and not the developer. One excellent characteristic is the rendition of blacks (maximum density or "D-max") with this film. This results in good color saturation which would be lacking in a color film that has brownish or greyish blacks. The "D-max" holds up quite well even at a one stop push. When the film was pushed two stops it started to go greenish as we stated before. This was still better than we had expected.

E-3 bleach formulas

Last month we mentioned that we would print the new bleach formulas for E-3 Ektachrome transparencies. These are selective dye bleaches and could be used to correct an underexposed transparency or one that has an excess of a particular color.

Bleaching is a bit tricky, so experiment *first* with some discard transparencies to see what effect each bleach has on the Ektrachrome when wet, and when dry. When bleaching a specific area is desired, a good frisket should be applied to the areas that are not to be bleached. Naturally the frisket should be applied to the emulsion side of the transparency. The times given result in a bleaching action equivalent in effect to something between a CC05 and CC10 filter, but this varies with the particular emulsion of film and purity of chemicals used. Attempts at greater corrections tend to lower the maximum density and desaturate all colors.

Before bleaching, the transparency should be soaked in a solution of Photoflo, 5cc per liter (or a comparable wetting agent), for 1 min.

The yellow bleach should be freshly mixed. It is made up as follows: sodium hypochlorite (Clorox.

Now 1 shot takes care of 5 tomorrows

Create one setup, shoot once, develop one set of negatives, to satisfy any wandering whim or future need of the boys in the front office.

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You can even make color-separation prints for R.O.P. color reproduction. (Use Kodak Resisto Pan Paper.)

Neither you nor the front office need make up your minds about what kind of positive you want before taking the picture. Go ahead and shoot for color. From then on, everything is done in the darkroom.

You've got control. With an Ektacolor negative in your enlarger, you can correct, dodge, mask, burn in, or what-have-you, for either black-and-white or color pictures.

(It looks like Ektacolor's the aspirin for a lot of industrial photographers' headaches.) Talk about it with your Kodak man, and by all means try it on a few test subjects.

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

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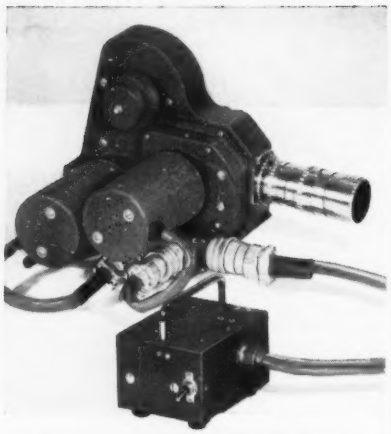

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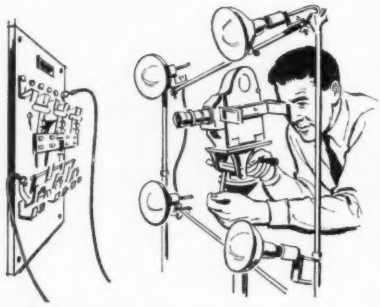

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Hilex etc.), 2cc; acetic acid, 28 per cent, 15cc; water (at 68°F) to make 1 liter. Use about 1 to 2 min. then wash transparency for 10 min. Soak in wetting agent again and dry.

The magenta bleach is composed of distilled water, 300cc; stannous chloride, 10 grams; distilled water to make 1 liter. This solution is used at 68°F for 2 or 3 min.

The cyan bleach is made up as follows: water (at 68°F) 750cc; sodium hydrosulfite, 0.5 grams; sodium acetate (desiccated), 20 grams; water 68°F to make 1 liter. This solution is also used for 2 or 3 min.

All the above times are approximate and, we repeat, should be tried on a discard transparency before attempting to bleach the desired one. In the event you want to bleach more than one color, the transparency should be washed ten minutes between bleaches. As Ektachrome film turns opalescent (milky) and more yellow when wet, it is a bit difficult to see color corrections take place. If there are several transparencies to bleach it is advisable that they all be soaked simultaneously in the wetting agent. This will enable you to check the bleaching effect of the transparency by comparison with another wet, but unbleached, transparency. It is best to bleach in small successive steps to avoid overbleaching. Bleaching removes color throughout the entire density range of the transparency, so over-bleaching can tend to lower contrast of the transparencies, as we stated before. If a transparency requires a great deal of correction it probably would be better not to fully correct the color than to risk overbleaching. This rule should apply to underexposed transparencies.

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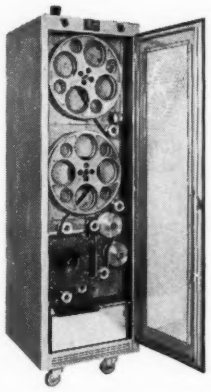

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INDUSTRIAL MOTION PICTURES

You will be happier with a film budget. Can happiness buy money?

When it comes to estimating production costs for films, there is no substitute for practical experience. And even experience, though necessary, is not sufficient for realistic budget planning. No amount of imagination can conceive all the unexpected circumstances that have driven up the costs of films; in fact, the underestimation by experienced film makers of the time and material needed in the various stages of production is chronic. For this reason, a contingency amounting to between 20 and 40 per cent of the total is not unreasonable—and this cushion is used up in most productions.

In spite of the chancy nature of film costs, there is a systematic way of planning film expenditures. It is a printed or mimeographed budget form, which is a check list of every conceivable expense on a production. Most of the forms used by producers are quite elaborate, containing a few hundred items. The in-plant film maker can utilize these lists as a basis for one that will suit his own needs. Industrial film makers can generally omit such items as costume rentals, make-up man, or set designing, but there is much that applies. Examination of a few of them usually proves to be a revelation.

Itemize!

To estimate a budget, a film maker must predict with fair accuracy dozens of particulars: the number of shooting days; the cost of a shooting script; the number of technicians, the duration of their service and their salary; the quantity of original shooting stock; equipment needed, its purchase price or rent; laboratory processing and print charges; cost of opticals and titles; animation; recording studio charges; the narrator; background music; sound effects; props; legal fees; insurance, etc.

When it comes to budget making the in-plant film maker is in an enviable position compared to the independent producer. A number of items, such as overhead and sometimes transportation will not show up in his budget. The company already possesses a personnel payroll and often its own equipment. An independent producer must include charges for rental of equipment, even for the equipment he owns; this is charged against his capital investment. He also charges for profit, because of the business risks he takes. This accounts for the sometimes surprising differences in cost between an in-plant produced film and a film contracted for by an independent producer.

Script is guidepost

The most important ingredient in a realistic film budget is a detailed shooting script, or at least a good outline that includes the length of the film, the scenes and the locations. This script must be translated into terms of time, materials, equipment and manpower.

But even with the guide of a script, a producer must acquire a well organized file of costs before he can start working on a budget. It includes price lists of motion picture materials; lab charges, equipment rentals; studio and recording charges and the prevailing wage scale for various craftsmen and experts. Most of these lists are easy enough to obtain by writing to the appropriate firms. The best source of wage scales is sample contracts obtained from the various motion picture craft union locals.

I realize that a lot of people see red when they hear the word "union." There is one practical point which even they must not overlook: the fact that the union is almost without exception the only source of reliable experienced technicians. Let's face it. There are lots of people who talk a good movie; who would like to make a good movie; but they do not have training or experience in this intricate medium. Most movie craftsmen are cooperative and take pride in their work. If the daily wage

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seems high one should keep in mind that these are free lance workers; they and their families must eat, even on idle days; and their average yearly income only rarely goes into five figures.

Let us come back to the budget problem. Regardless of his affiliations you cannot reasonably expect to get a competent technician to work on a short term basis for less than the prevailing union scale.

Don't undershoot

The quantity of raw stock needed for a film depends greatly on the length of the finished film and the shooting ratio. The minimum for a narrated industrial which has visual continuity is considered to be about 5:1, five times as much film is shot as is ultimately used. This holds true only if a tight shooting script exists. If the script is general, and the shot list is made up on location on the spur of the moment, or depends on subject behavior, the ratio will go up and approach 8:1, 10:1 or even more.

It is often more wasteful to be too tight on the original material than to overshoot. In the editing stage, the extra footage comes in very handy—if re-shooting is necessary any "savings" which may be present are quickly eaten up.

Consider rentals

The problem of figuring the cost of equipment is simplified by the numerous excellent firms that rent any type of equipment at reasonable rates *(see PMI, Aug. 1958)*. It is impractical and financially unsound for a small scale film maker to buy very elaborate and expensive equipment even if he or the firm can afford it. I don't mean a modest camera, or a set of lights. Each film calls for a different set of equipment. You may buy gear for a sync sound film; your second production may be a narrated documentary that calls for light portable equipment. Another point to consider is the fact that the actual shooting stage for a film is quite short when compared with the time involved in planning, writing and editing. So let's say you need a good synchronous camera for a sound film for a period of two weeks. You may not use that camera again for six months or perhaps a year. It would certainly be impractical to pay $10,000 for the camera when you can rent it for two weeks for $400. This way, you can get the exact equipment you need for each shooting problem. Most independent producers by the way rent about 80 per cent of their lighting, sound and camera equipment.—THE END

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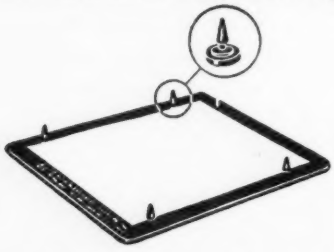

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MICROREPRODUCTION

(*continued from page* 14)

scale research papers and instructional manuals. In its excellent series of data books the Eastman Kodak Company has one on microfilming which is an excellent primer for the beginner. Film and paper manufacturers will gladly supply information about sensitive materials, processing formulas and handling. Sometimes sections of books dealing with a particular camera and accessories will contain useful material. One of the best examples is the *Leica Manual* edited by Morgan & Lester which has sections describing in some detail how to make microfilm copies with the Leica. The same procedures may be followed with any similar miniature camera and the method while it is not suitable for professional production work will certainly demonstrate the principles involved. It is possible moreover to use a camera of this type to make microfilm records of the literature of microreproduction and so accumulate experience and a working data collection at the same time. Many scholars use miniature cameras to copy documents in libraries and archives to further their research.

Expert advice

The final approach is to consult an expert in the field if one can be found who is willing and has time to talk. Here again library microphotographers or those employed in some branch of government service are a good choice, for they are salaried and not subject to the heavy time pressures of the commercial world. Unfortunately many people seem to forget that it is a privilege and not a right to ask questions and consider an expert fair game. He is fair game if you pay him, but then he becomes a consultant and not an advisor "for free." If a large project or a considerable saving is involved, then he may be worth his hire.

It may be elementary to stress the fact that a systematic approach to the search for information about microreproduction is essential if worthwhile results are to accumulate. The essentials of microreproduction are comparatively simple and easy to comprehend. A systematic review and mastery of ten essential factors: camera set-up, lighting and exposure, processing film and paper printing, spooling, splicing, reading and storage, together with something to reproduce and *a reason for making the reproduction* cover all of the basic factors. Everything else is an elaboration or an application.—THE END

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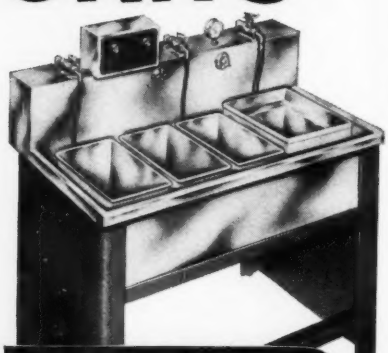

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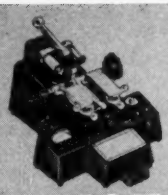

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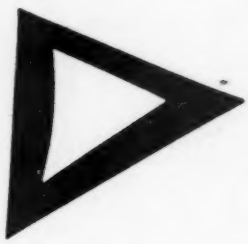

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16mm B & W Processor 112

Operating to 40 ft. per min., a "fully automatic" 16mm black-and-white processor, the Houston Fearless Labmaster, processes negative or positive film—and is designed so that an extra unit can be added for reversal processing. Construction features are: stainless steel tanks, built-in refrigeration system, turbulation pumps on developer tanks, air compressor and clutch-drive film transport that is said to eliminate film breakage. Negative-positive model is priced at $4,175.

8/16mm Hot Film Splicer 113

Automatic removal of film emulsion for splicing is accomplished by a patented, fully adjustable, motor driven rotary cutter, in the 8/16mm Automatic Hot Splicer made by Western Cine Service.

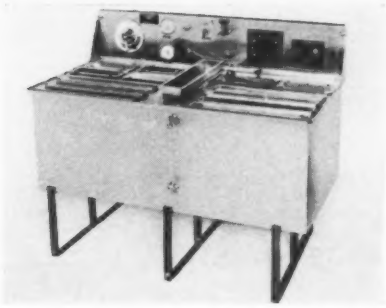
After the film has been locked in the platens, a push of a button activates the cutter which travels the full width of the film, removing the emulsion to "exactly the proper depth." The automatic feature suits it to darkroom use, it is said.

Other features are: adjustable splice width; dual film registration pins centered on the platen to permit splicing of sound stock with perforations either toward or away from the operator; constant platen temperature of 99-101°F.; compactness and one year guarantee. Price: $229.50.

5-Ft. Color Lab 107

Processing color films, both negative and positive in roll or sheets up to 8 x 10—and developing color print paper and print film up to 16 x 20 are said to be possible in the 5-ft.-long Rolor Universal Color Laboratory.

Three and a half gallons of processing solutions are used for color print paper and film. A 2-gal. tank insert incorporated in the film section is said to increase solution economy. The film tanks provide for processing nine 120 and fifteen 35mm rolls or thirty-two 4 x 5 sheet films per run, it is said.



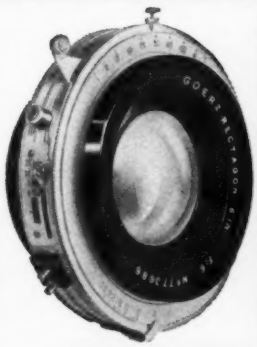
Nitrogen gas distributors—incorporated on the baskets, racks and cages of all solution tanks—release timed bursts. The distributor feed lines "jack" into flow control valves located on a master panel.

The laboratory may be supplied with the Rolor Automatic Replenishment System as original equipment, or the unit may be furnished preadapted—with tank insert feedlines, tank overflows and jacket couplers—for future installation of the replenishment system.

Oscilloscope Magazines 116

Continuous-motion 35/70mm film magazines for use with Beattie Oscillotron cameras in recording transient phenomena from the face of cathode ray tubes are announced by Beattie-Coleman, Inc. Each magazine has 100-ft.

GOERZ



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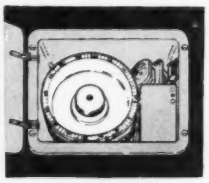

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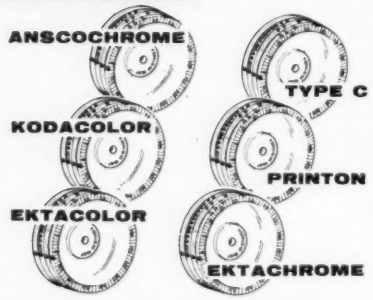

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Reel E-Z Corporation
1112 Chestnut Street Burbank, Calif. TH 5-3569

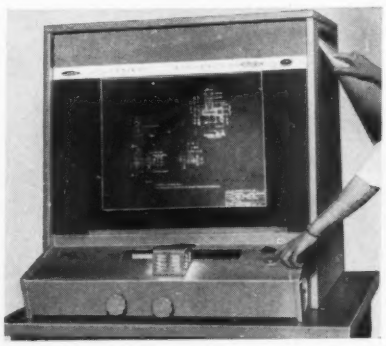
Get more information. Circle 479, page 61

film capacity. Film speed is adjustable in each by means of spur gear changes for 1/16, ⅛, ¼, ½, 1, 2, 4 and 8 in. per second. 35mm aperture size is approximately 1 x 1½ in. Aperture in 70mm model is approximately 2¼ x 2¼ in. The film transport is driven by a 115V, 60 cycle synchronous motor employing a standard 16-tooth sprocket. Film perforation is American Standard PH 22.93-1953 wound on No. 10 Eastman Kodak spools. A magazine footage indicator is included.

Microfilm Reader-Printer 110

A single unit microfilm reader-printer, capable of producing prints in less than 15 sec. with the push of a button is the Thermo-Fax Twenty-Nine. It accommodates 35mm film in aperture or tabulating card sizes. The manufacturer, Minnesota Mining and Mfg. Co., says that sharp, enlarged, permanent copies are produced—and any number of copies can be made by repeatedly pressing the button.

A masking control permits selective printing of full or half-size prints. The machine uses a roll of Thermo-Fax microfilm copy paper with a capacity of one hundred 18 x 24 prints or two hundred 12 x 18 prints. Individual 18



x 24 prints can be obtained for as low at 20¢ each for materials, it is said.

A table-top unit, the reader-printer stands 32 in. high, 31 in. wide and 36 in. deep. The machine can be loaded in normal office light, operates on house current, requires no plumbing or special facilities.

The lens provides a magnification of 15X and will cover a standard D size aperture. Price: $919.

New Mono Baths 122

A single processing solution which develops and fixes films in "only six minutes" has been announced by Cormac Chemical Corporation. Unibath CC-1 is for processing all standard films, normally exposed. CC-2 is for forced developments of under-exposed films. CC-3 processes most standard photo papers in three minutes.

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IN-PLANT TEST

Avery Color Labs match wits with Densi-Color Analyzer, new electronic brain for color printing exposures

Specifications: Lektra Densi-Color Analyzer PTM-6 reads three colors simultaneously to give correct printing time, proper color correction filter for color prints. Complete unit consists of three components, Control Console, Optical Heads and Standards-and-Power Supply. Control Console gives correct printing time, reading from .8 to 120 sec. Three meters measure red, blue and green light to give correction filters needed. Zero adjustment for each meter. Built-in timer can be removed for servicing without affecting operation of console. Optical heads read white light for exposure time, red, blue and green light for filter determination. Standards-and-Power unit is electric brain, storing corrections to be used as needed. Each adjustment has "coarse" and "fine" knobs. Two models, Mark I for one paper emulsion adjustment, and Mark II, for three emulsion adjustments. Five channels provide five standards (e.g. flesh tone) which may be set as desired. Prices: PTM-6-Mark I, $1560; PTM-Mark II, $1800.

Morton P. Hecht reports: Here at Avery Color Labs, we are concerned primarily with turning out custom color prints and first quality production prints using the Ektacolor process. To deliver prints which meet the high standards of our clients, the majority of whom are top photographers on industrial and advertising accounts, we make extensive use of densitometric controls and automatic laboratory facilities. Therefore we were much interested in Lektra's new Densi-Color Analyzer.

To make our tests on the device we began by exposing a series of 24 negatives, one a normal negative as far as exposure and light balance were concerned. The other 23 ran the gamut from extreme over- to extreme under-exposure, with the light being filtered through blue, green, red, yellow, cyan, magenta and other filters. Our subject was an attractive model who held a card containing exposure data, an 18 per cent reflectance grey card, a grey scale and a set of color patches. We felt that virtually all the departures from normal found in color work would fall within this range.

Our regular procedures were followed with the normal negative. It was analyzed in a Densichron II in conjunction with the Densichron light box for color balance. A Densichron I was used to measure light intensity giving us correct printing time. All processing controls—filtered water, temperature regulation, air conditioning for both heat and humidity, analysis of pH values—

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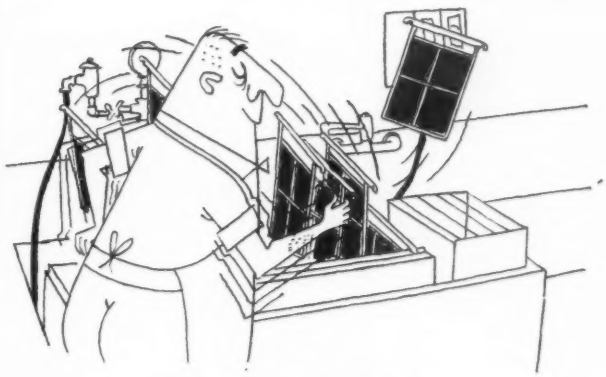

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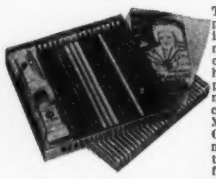

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Get more information. Circle 457, page 61

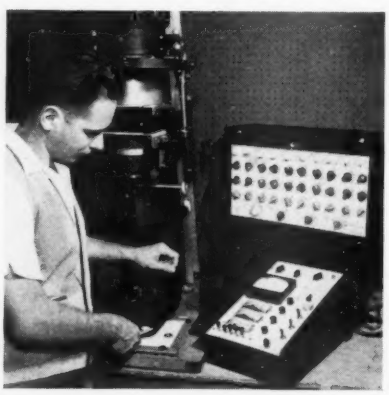
were used to give us as good a print as we could possibly get. Thus we arrived at proper color balance and exposure time for our negative.

This done, the normal negative was replaced in the enlarger to standardize the Densi-Color Analyzer for our equipment and materials. Channel I came first. The color adjustment dials of Channel I were set after the tri-color probe was positioned beneath the grey card image of the negative. The color probe was then replaced by the exposure probe and the circuit adjusted to indicate the exposure given our standard finished print. Channel II was then employed to set up similar standards for flesh tone readings.

Control channels

Although we used but two channels there are five available channels, the remaining three being adjustable for any known, frequently used standard such as light or dark skin, foliage, sand in beach scenes, etc.

We used our normal negative to begin testing, then proceeded to our test negatives. The Control Console of the unit, in each case, indicated the proper changes in color correction filters; a built-in timer controlled the duration of exposure. After each negative was printed, the paper was set aside so that all test prints in the group could be developed simultaneously. Each negative in the series was placed in the enlarger, analyzed



and corrected at the easel. The operator doing the printing was able to finish the job in record time.

When the test prints were developed, the result was a pleasant surprise to everyone in the lab, even the most pessimistic. The majority of the prints were accurate with plus or minus the equivalent of a CC05.

One of the outstanding features of the Densi-Color Analyzer is the ability of the computer to be adjusted for the particular paper emulsion in use. In a large lab such

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as ours, we stock papers in seven sizes, each in two batches. One is our "working stock," the other held in reserve. Thus, it is entirely possible that 14 sets of filter factors might be necessary to obtain proper color balance for every batch of paper in the house. On the analyzer, the factors for each batch of paper may be set in the computer, yielding 14 possible combinations per channel. With the five channels there are actually 70 correction combinations stored in the computer, all available at the twist of the four dials.

Evaluation

We found in ten days of testing that the Lektra Densi-Color Analyzer PTM-6 was of inestimable value in reading negatives which came in without any exposure information, something which is becoming more common. While we did not feel it was critical enough for really top-quality work, it proved capable in getting excellent first tests.

The equipment is also a reflection densitometer, but this phase of its operation was not checked by us, as we use visual correction in our normal procedure.—THE END

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E. F. TECHNIQUE

(*continued from page* 48)

give them exposure checks, using sheet film or Polaroid materials. The latter is especially convenient to use for check purposes as the results can be seen almost immediately.

Electronic flash meters

For some ten years, an Edgerton-designed exposure meter for electronic flash has been built and sold by General Radio Co. It can be used as an incident or reflected light meter or with a probe to read from the ground glass. Many photographers have placed half a ping pong ball over the phototube opening to provide a hemispherical collector. Just last month a new model was announced which is far more compact and reads directly in ASA exposure indexes. *(See page 70).*

The Thomas Strobemeter was reviewed in the March issue. These meters differ in the details of their use, but all are being used successfully by many photographers.

You supply the brains

Meters must be used intelligently. The meter does not record the effect on color saturation of highly diffuse lighting as opposed to the effect of spots. The validity of making a ground glass reading with a probe of a grey card area is open to question when rim or edge lighting is used. The exacting photographer would have to make a great many readings in different picture areas. He would have to know what ratios he needed, and how to place the lights to get them.

Cheap insurance

All this is not to be regarded as anti-meter talk. The meters, even for $200 to $300, are cheap picture insurance and contribute much to the photographer's peace of mind. The use of a meter does not substitute for experience and knowhow. Even many a meter enthusiast does not realize how much he himself is contributing to the meter's success.

Meters are useful, too, for routine checks of flashtubes and flash equipment, for checking the characteristics of various reflectors and for quickly determining the guide numbers of new equipment or the output with various combinations of capacitor banks. Successful color with electronic flash simply requires careful consideration of all the factors that are important with other light sources plus some accurate guide numbers to serve as a starting point.—THE END

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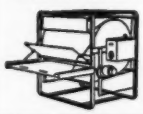

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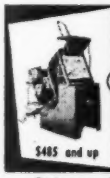

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COLOR ACCURACY

(*continued from page* 34)

assignment in color photography which demands exact color reproduction. Rather, it should be explained point blank that no such thing as exact color reproduction exists, except in very special instances.

Now this does not mean that color photography cannot be usefully employed in the technical areas of industry. For example, if a metal part of a piece of equipment tends to change in color under certain conditions of use, there is no reason at all why before and after pictures cannot be made to show the general trend of this change. Copper metal may not reproduce in a color transparency *exactly*, but it will look like copper. If its color changes on the surface during use to a bluish-green, a second color transparency will record it as bluish-green, even though again the reproduction is not exact.

In other words, color films usually reproduce colors so that we can relate blues, reds, yellows, etc., within a scene to similar hues in the reproduction. But this is not invariably true. Some flowers, for instance, that visually are blue in color, reproduce "purplish" because of their high reflectance of red light which affects the film to a greater extent than the eye.—THE END.

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ELECTRONIC FLASH

(*continued from page 24*)

battery in a separate pouch to power tubular capacitor cases with interchangeable heads. One, only 2 in. in diameter at the outer rim of the reflector was for narrow beam angles of 40 degrees. The other had a 3-in. diameter and a 60-degree angle. Capacitor cases could be stacked so that heads can be used with 35 or 75-watt-seconds.

New models, new prices

The new Dormitzer Sixty seems to be a practical and soundly-constructed unit. A permanently sealed nickel cadmium battery feeds two transistors which have adequate "heat sinks" to keep them cool. The 60-watt-second unit is given a Kodachrome guide of 50, yet weighs only 36 oz. Recycle time is 10 to 12 sec., but a fast cycle button permits 5 to 7-sec. recycle with momentary increased battery drain. This pocket-sized pack provides space for an additional battery to double the number of flashes.

Ascor announced not only a new portrait unit, but major price reductions as well. The new AC portrait unit handles up to four lamps, and recycles in 8 sec. The modeling lamps are standard clear incandescents to give increased intensity and reduced operating cost. Some may take exception to their mounting position in front of the flashtube, but for all practical purposes, they should serve very well. Guide number is given as 60 with Ektacolor Type S.

Speedflash meter

Ascor and the General Radio company jointly announced a new Integrating Light Meter for Electronic Flash. You recall that General Radio has for over ten years produced (unchanged) the Edgerton Integrating Light Meter for flash. The new unit is about one-fourth the size. The dial is calibrated in ASA exposure indices from 8 to 400.

The meter is used as an incident light meter or with a probe to read directly from the ground glass. The light sources are adjusted till the meter reads the ASA index of the film being used. It is said to have greatly increased sensitivity. Price is $280 less batteries. (Oh why oh why on items costing this much do batteries needed to make it work have to be an extra?)

Within the next few months, the writer hopes to make some comparitive tests of various meters for flash. Those who are meterminded seem to have strong feelings about the merits of models available.—THE END

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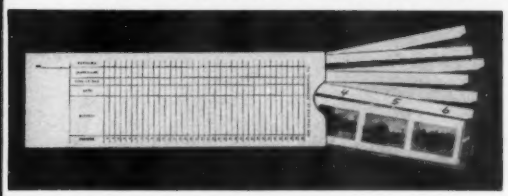

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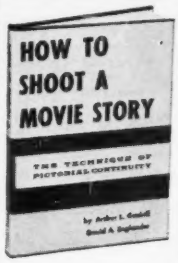

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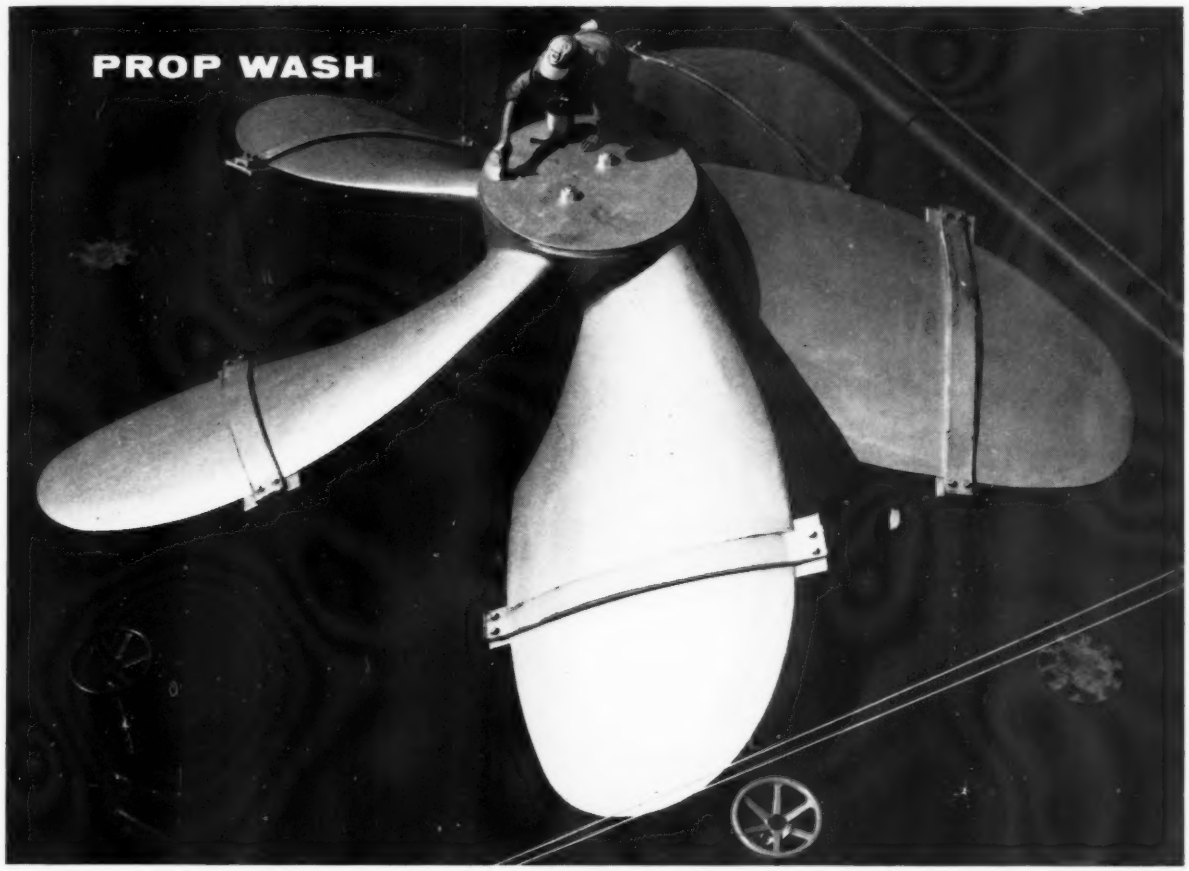

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